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Kwon et al.

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(45) **Date of Patent: Apr. 4, 2023**

(54) **REFRIGERATOR**

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(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

Jan. 8, 2021 (KR) 10-2021-0002864

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F25D 23/12 (2006.01)
F25D 23/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***F25D 23/126*** (2013.01); ***F25D 11/02*** (2013.01); ***F25D 23/028*** (2013.01); ***F25D 23/04*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC F25D 23/025; F25D 23/028; F25D 23/126; F25D 2331/81; F25D 11/02; F25D 23/04;
(Continued)

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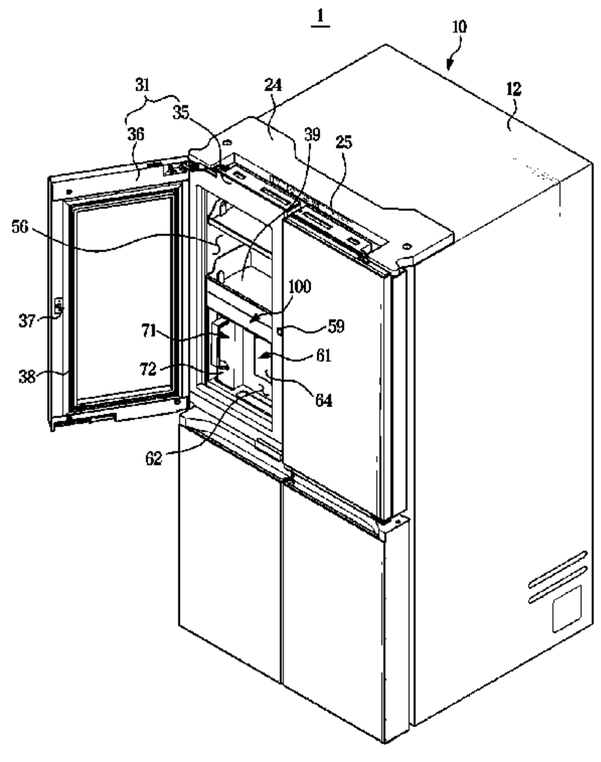
(74) *Attorney, Agent, or Firm* — Staas & Halsey LLP

(57) **ABSTRACT**

A refrigerator including a main body having a storeroom, an inner door rotatably coupled to the main body and having a door opening, an outer door rotatably arranged in front of the inner door to open or close the door opening, a dispenser including a water-intake space and an operation lever and configured to supply water to the water-intake space by manipulation of the operation lever, and an automatic water supplier including a water container installation space formed to have a water container mounted and a water level sensor configured to detect a water level of the water container, and configured to supply water into the water container to fill the water container with a certain amount of water. The water-intake space and the water container installation space may be arranged in the door opening of the inner door to be accessed while the inner door is closed.

10 Claims, 23 Drawing Sheets



(51) **Int. Cl.**
F25D 29/00 (2006.01)
F25D 23/04 (2006.01)
F25D 11/02 (2006.01)

(52) **U.S. Cl.**
CPC ***F25D 29/005*** (2013.01); *F25D 2323/121* (2013.01); *F25D 2323/122* (2013.01); *F25D 2700/00* (2013.01)

(58) **Field of Classification Search**
CPC F25D 29/005; F25D 2323/121; F25D 2323/122; F25D 2700/00
USPC 62/377; 312/291
See application file for complete search history.

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FIG. 1

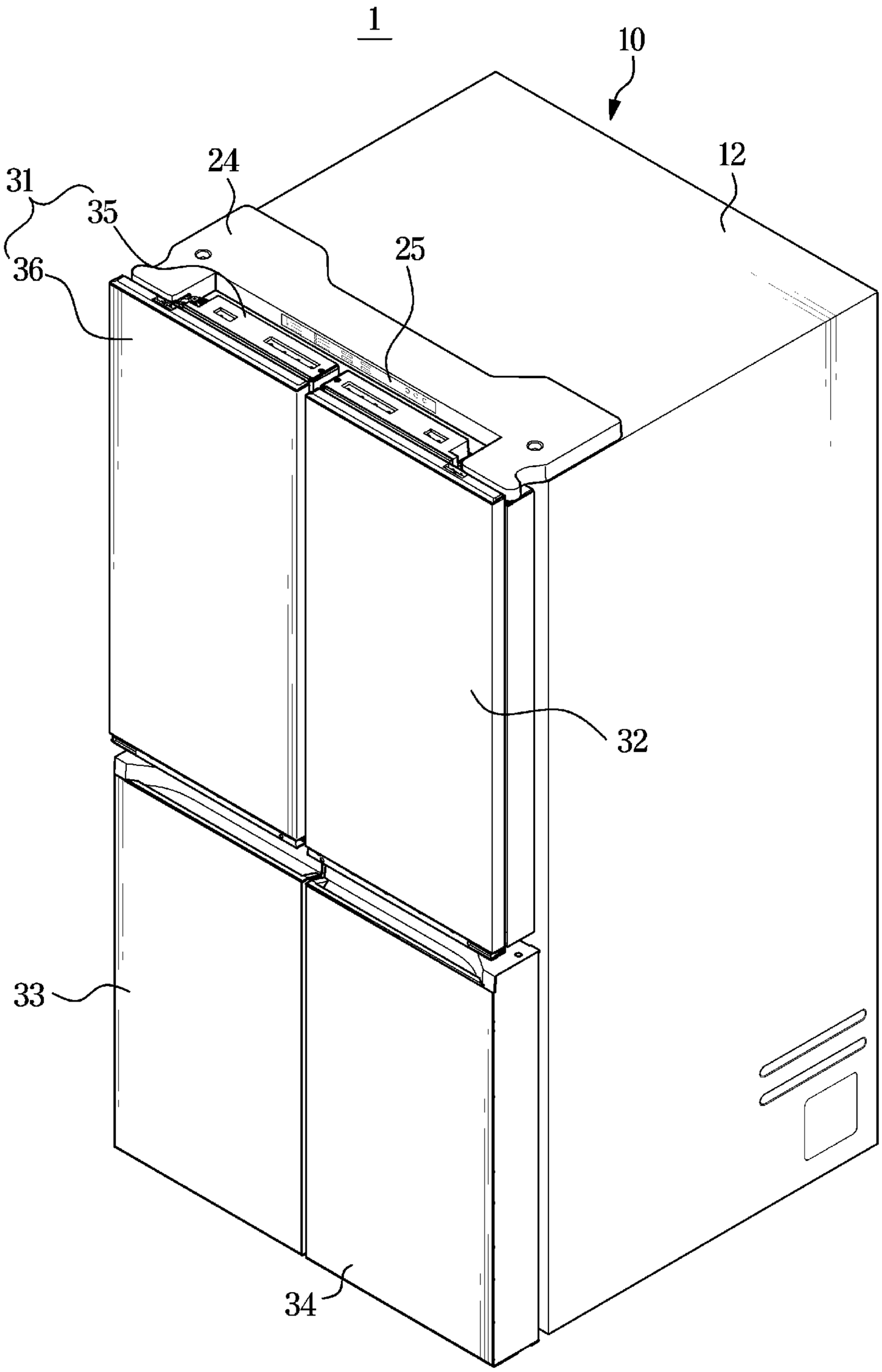

FIG. 2

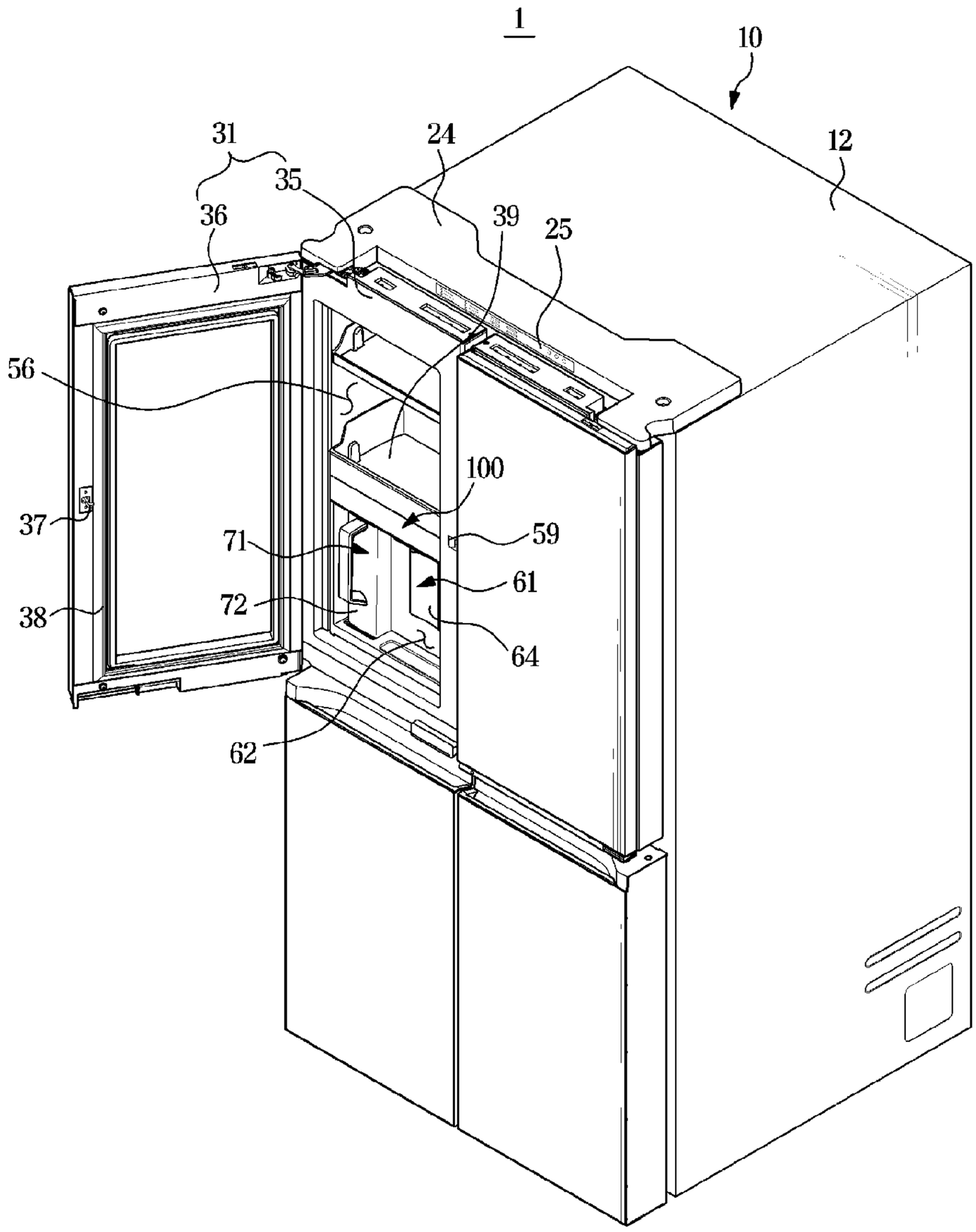

FIG. 3

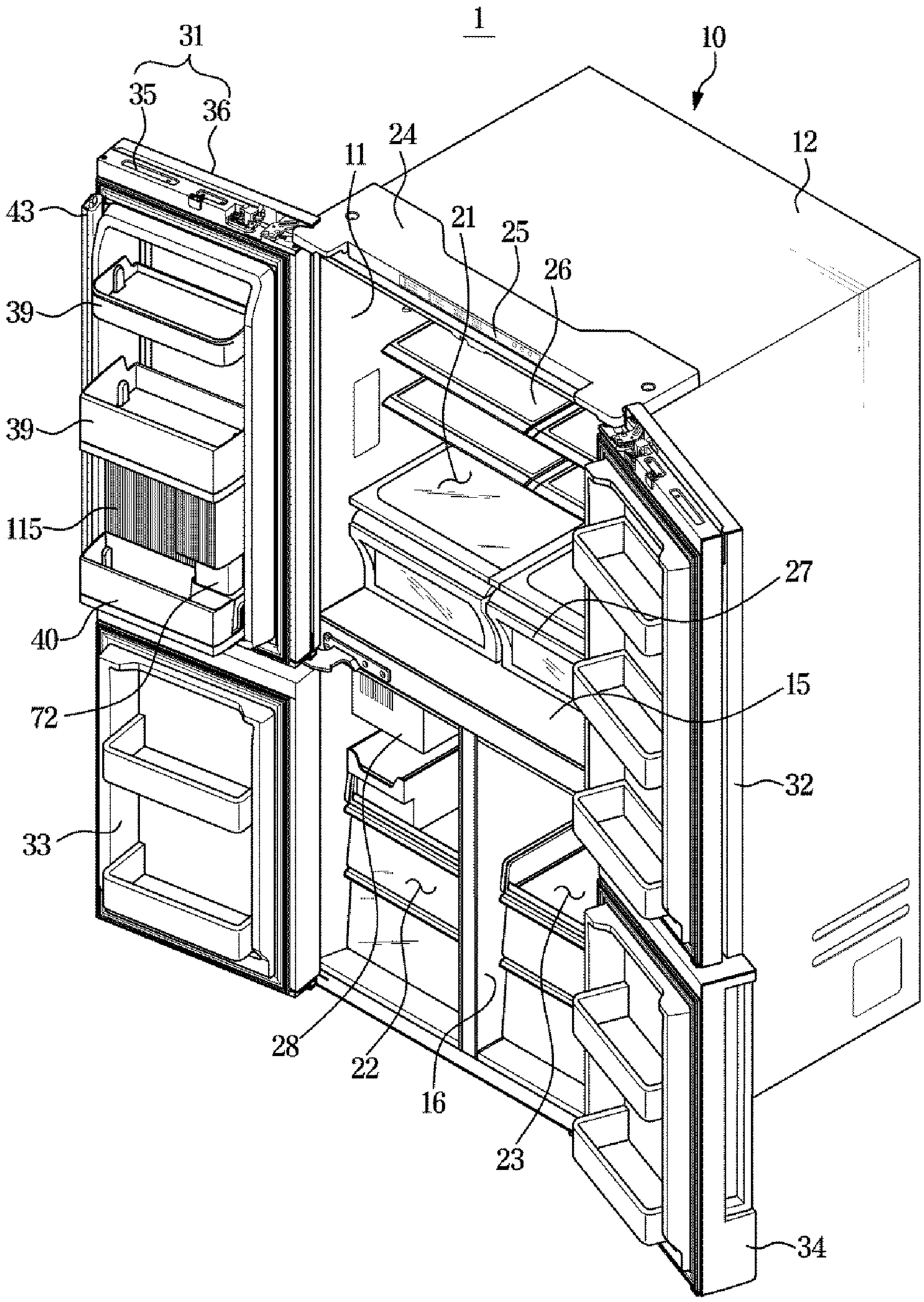
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FIG. 4

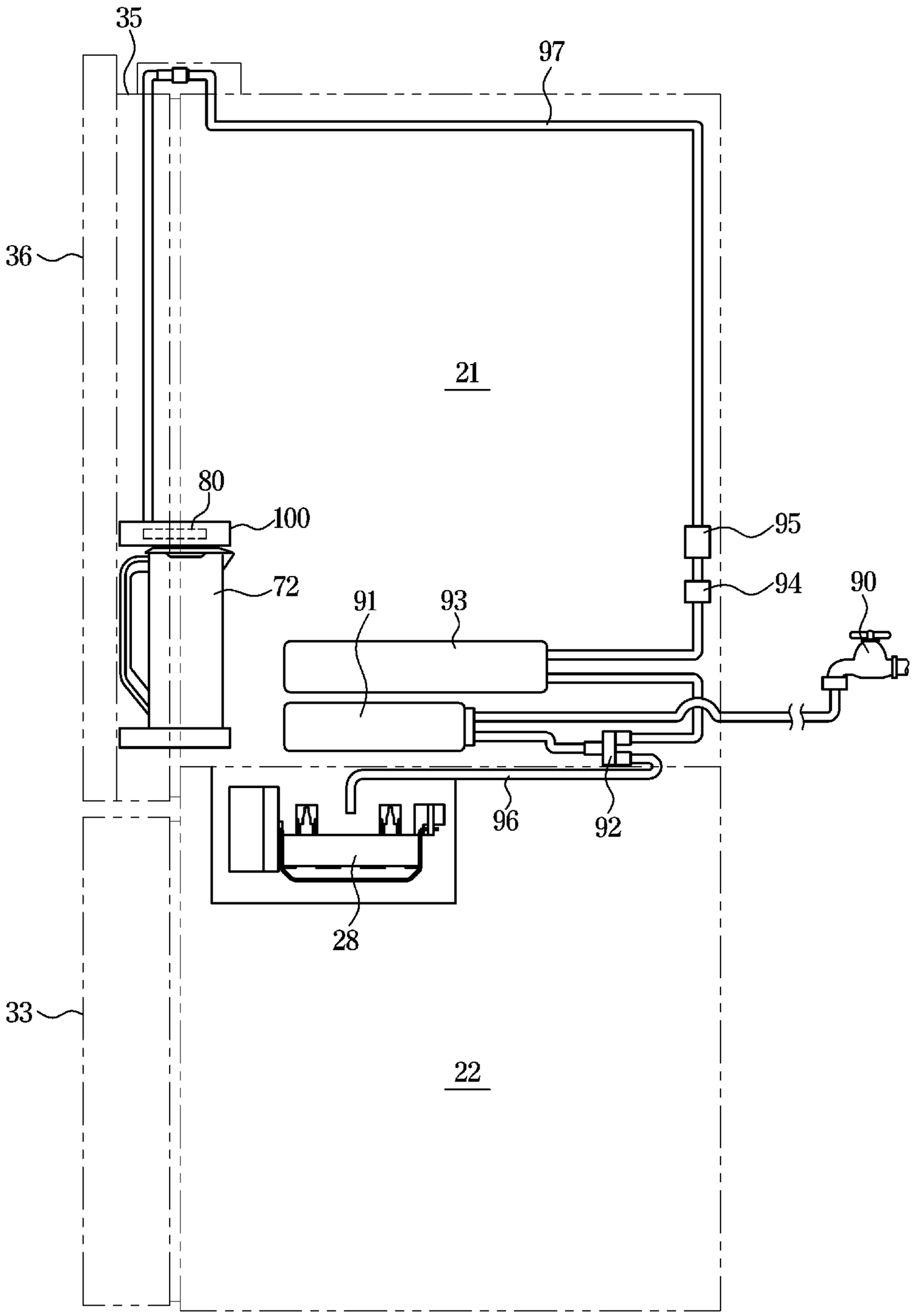

FIG. 5

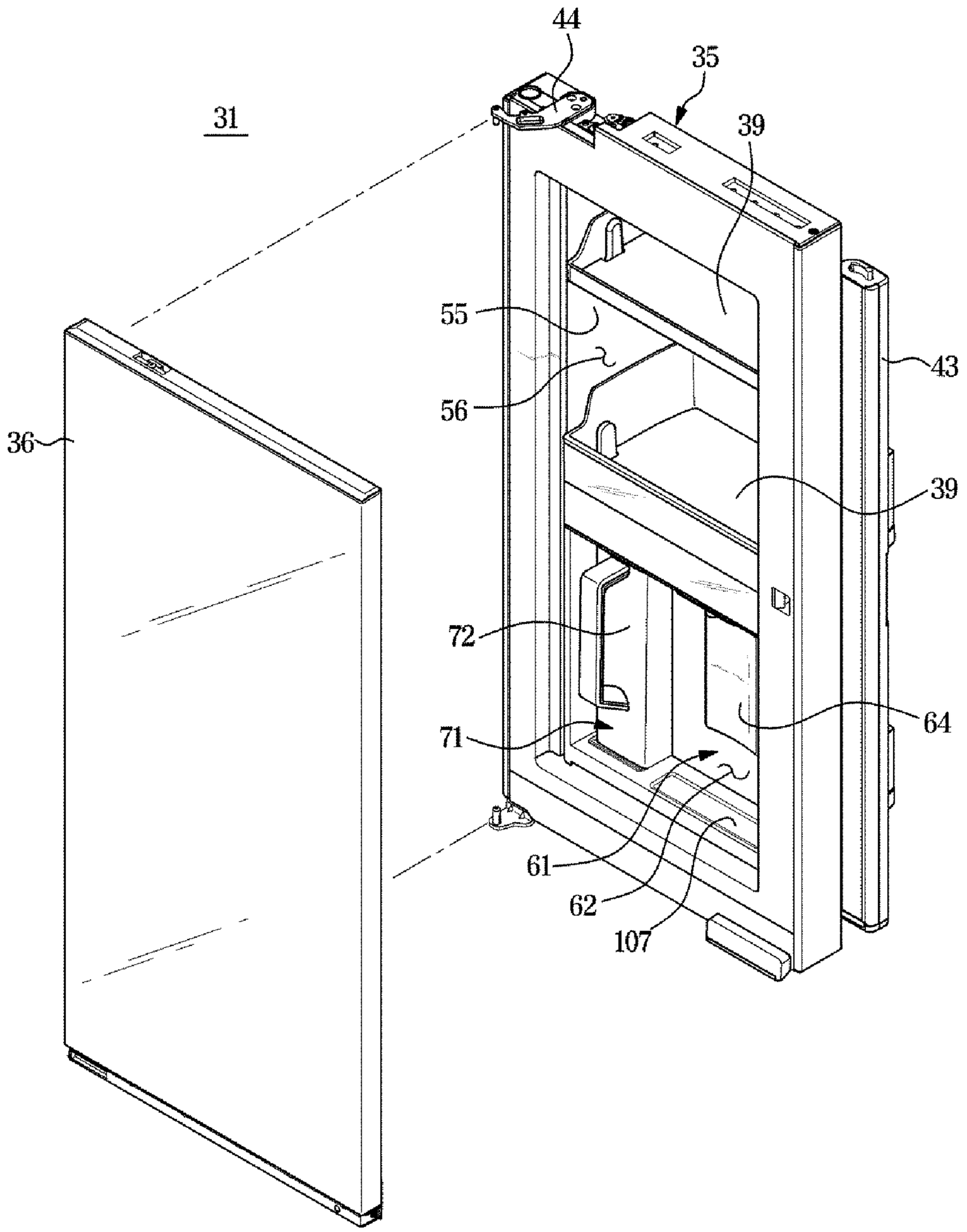

FIG. 6

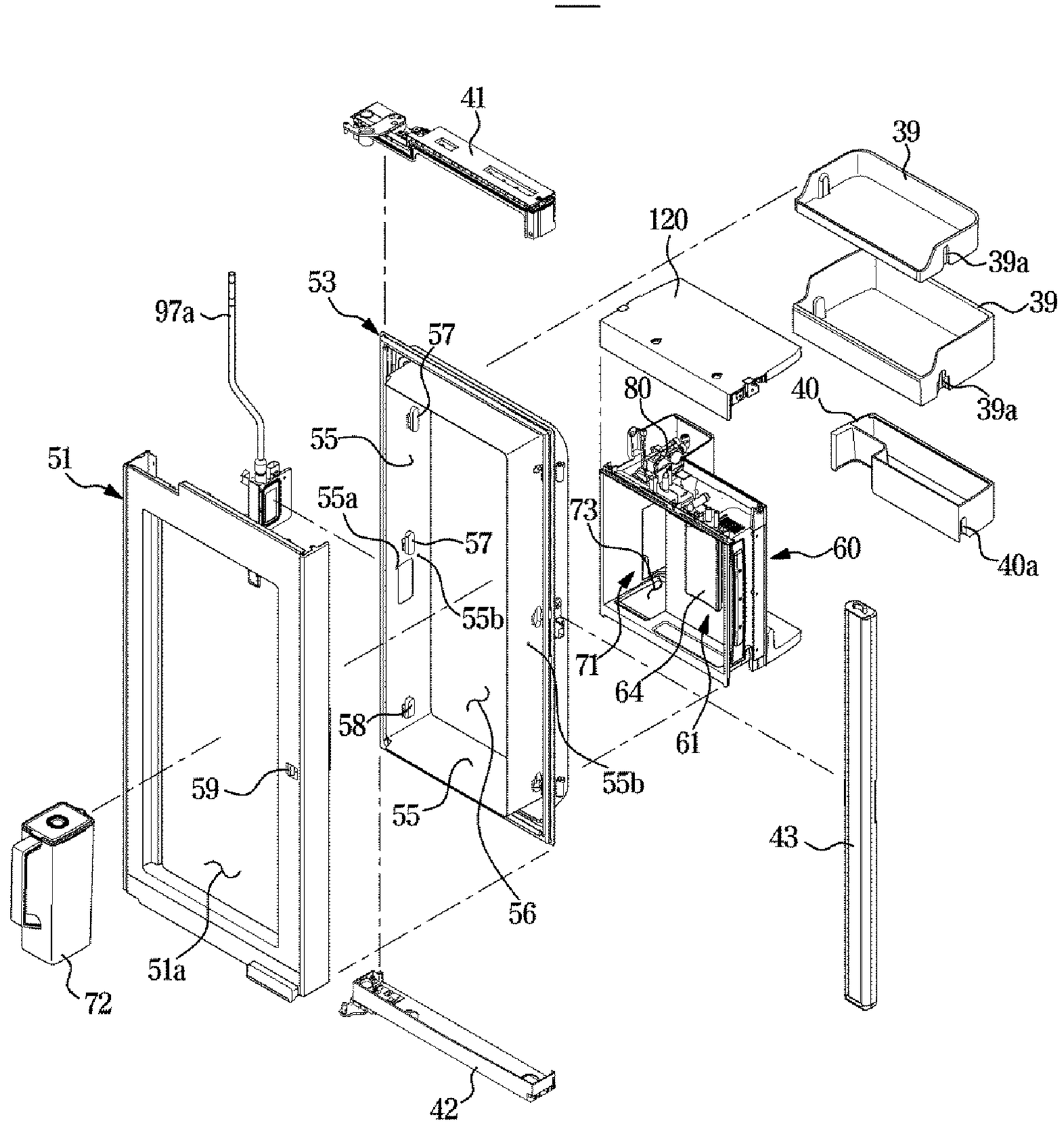
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FIG. 7

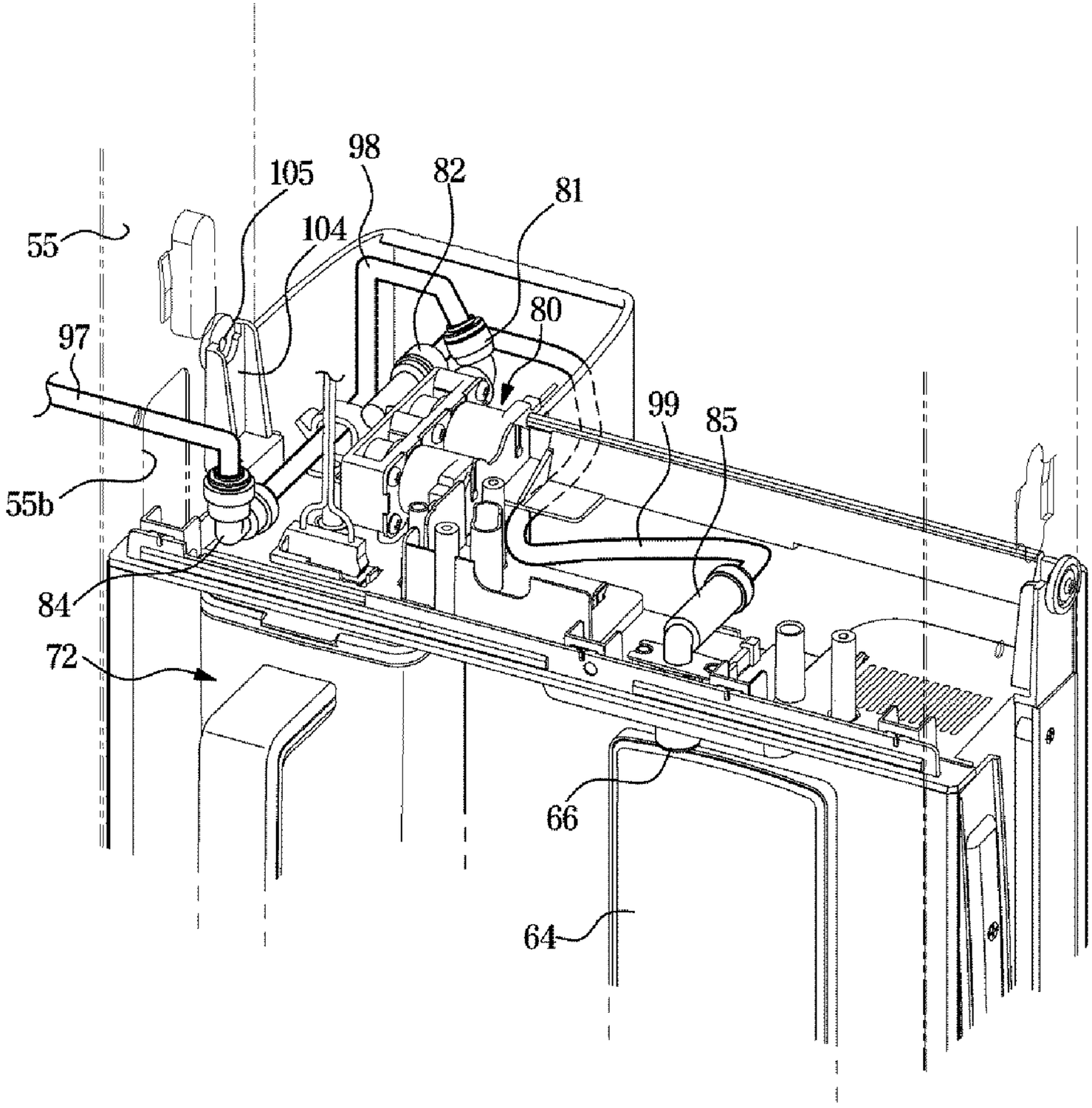

FIG. 8

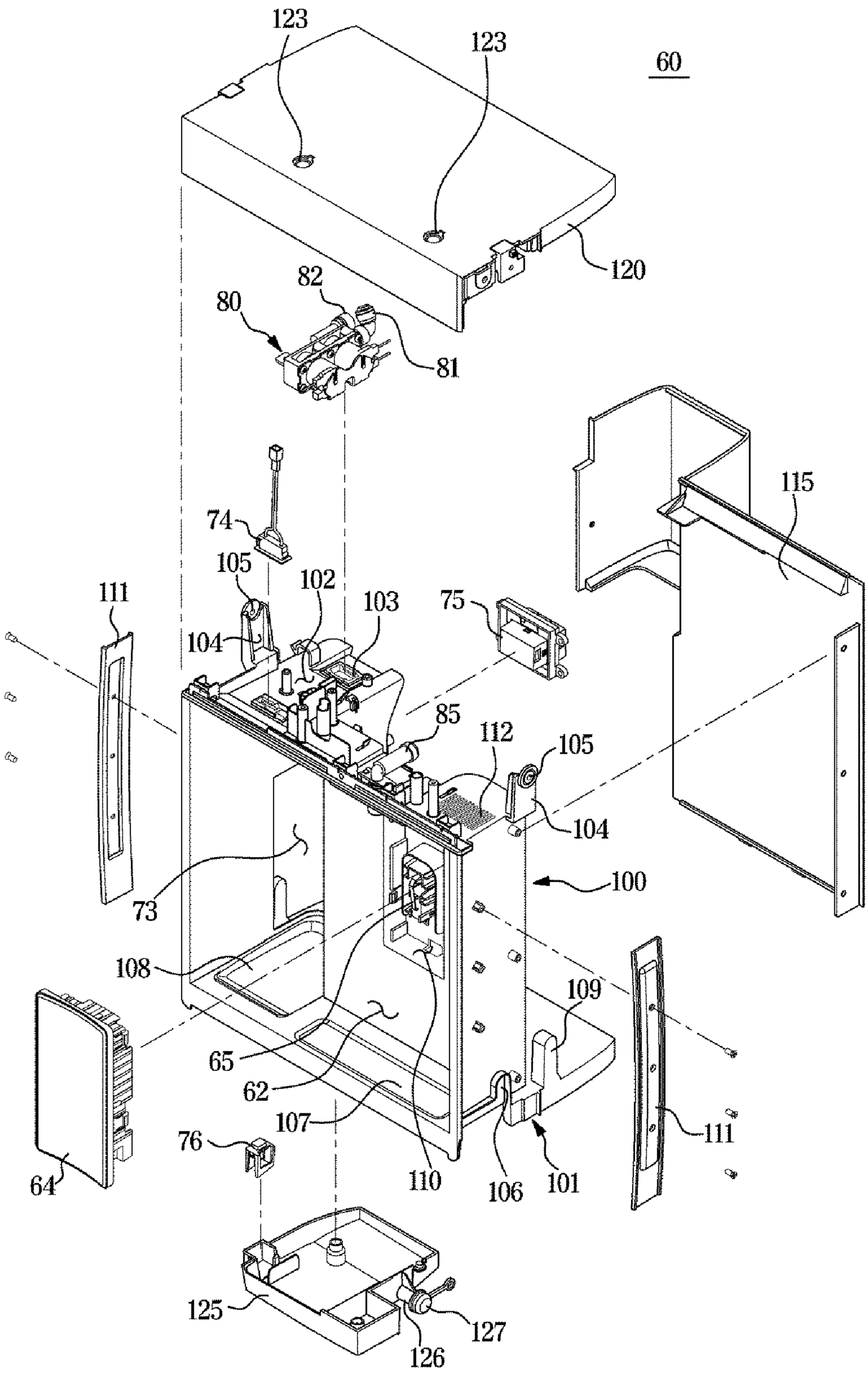
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FIG. 9

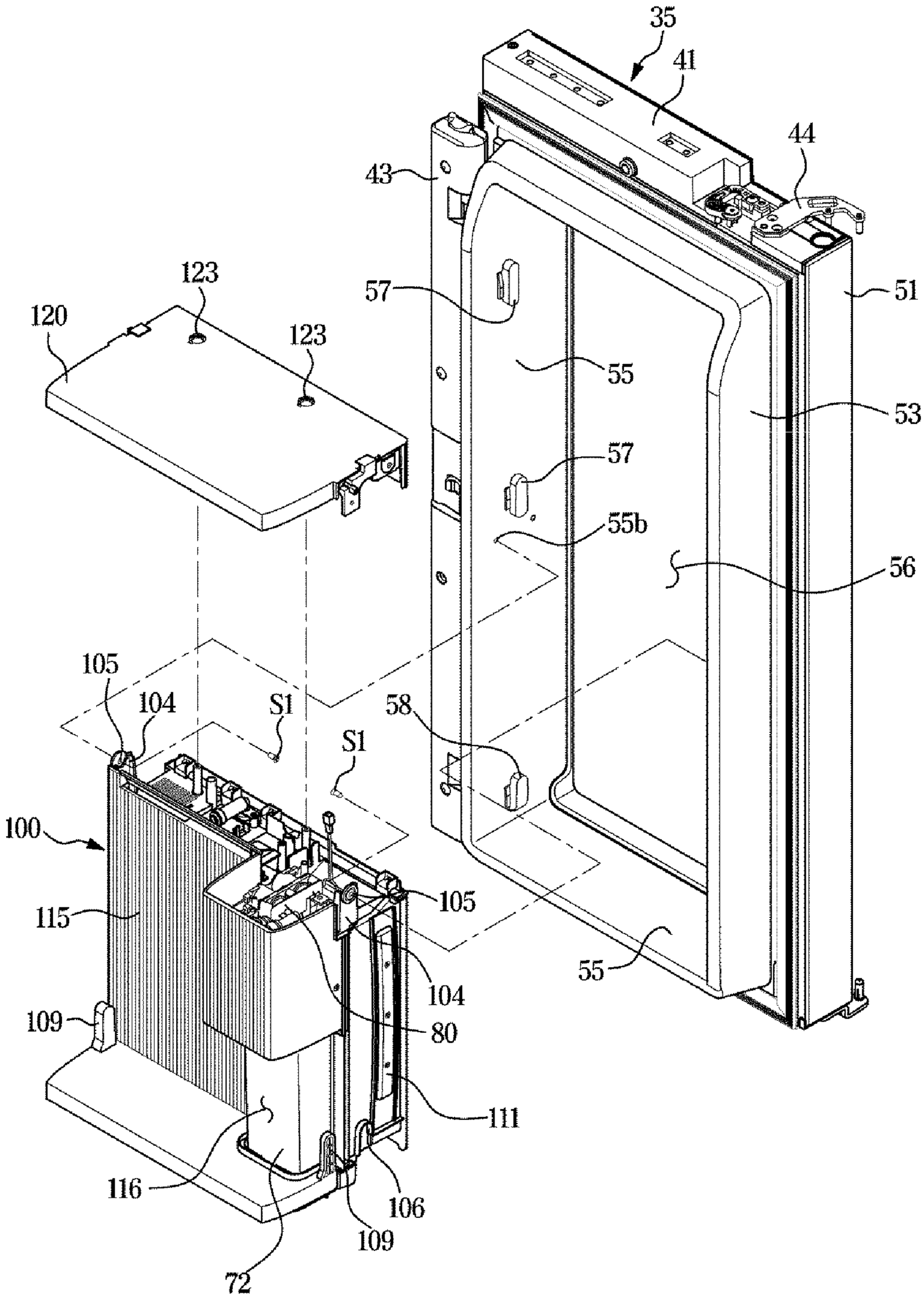
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FIG. 10

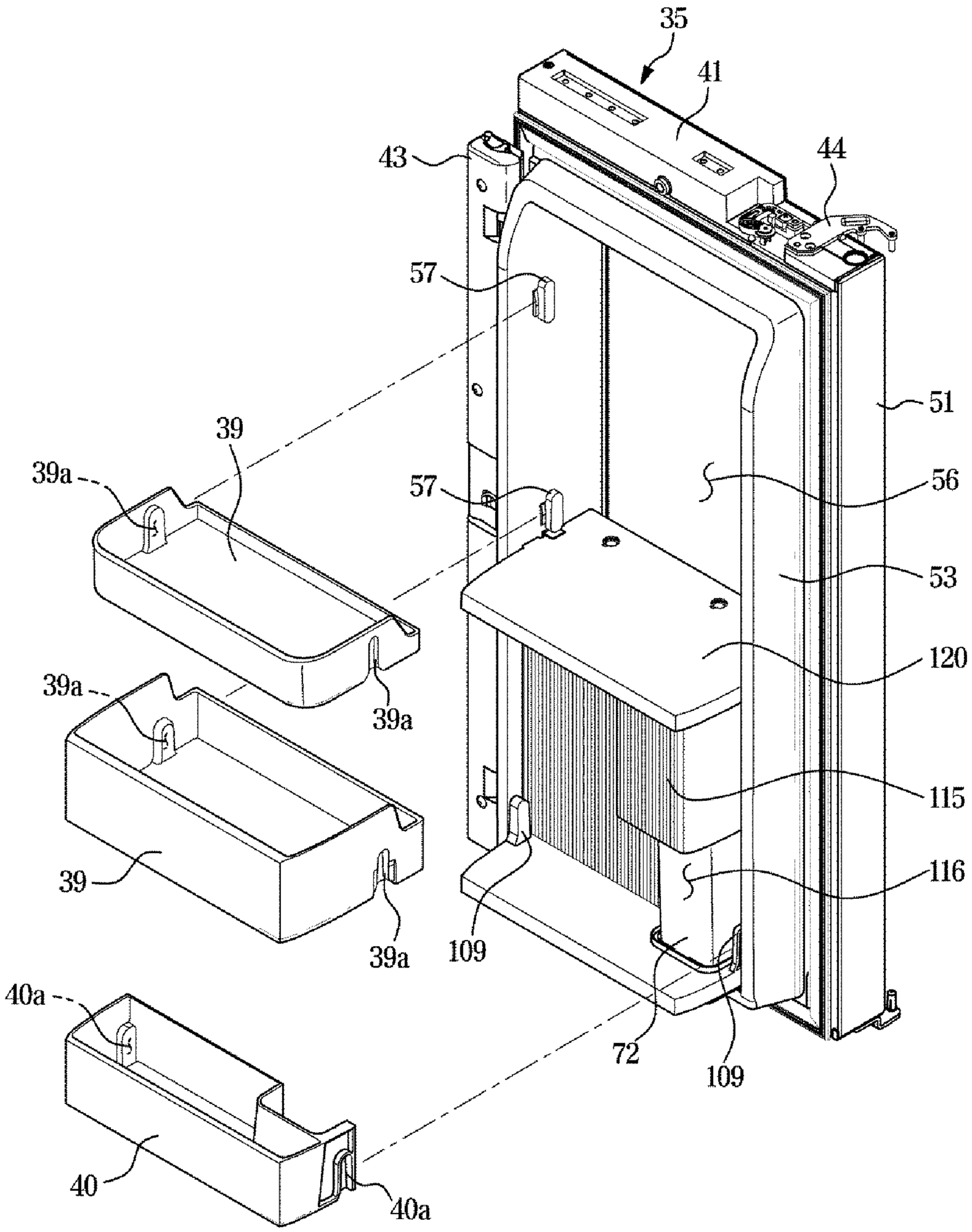
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FIG. 11

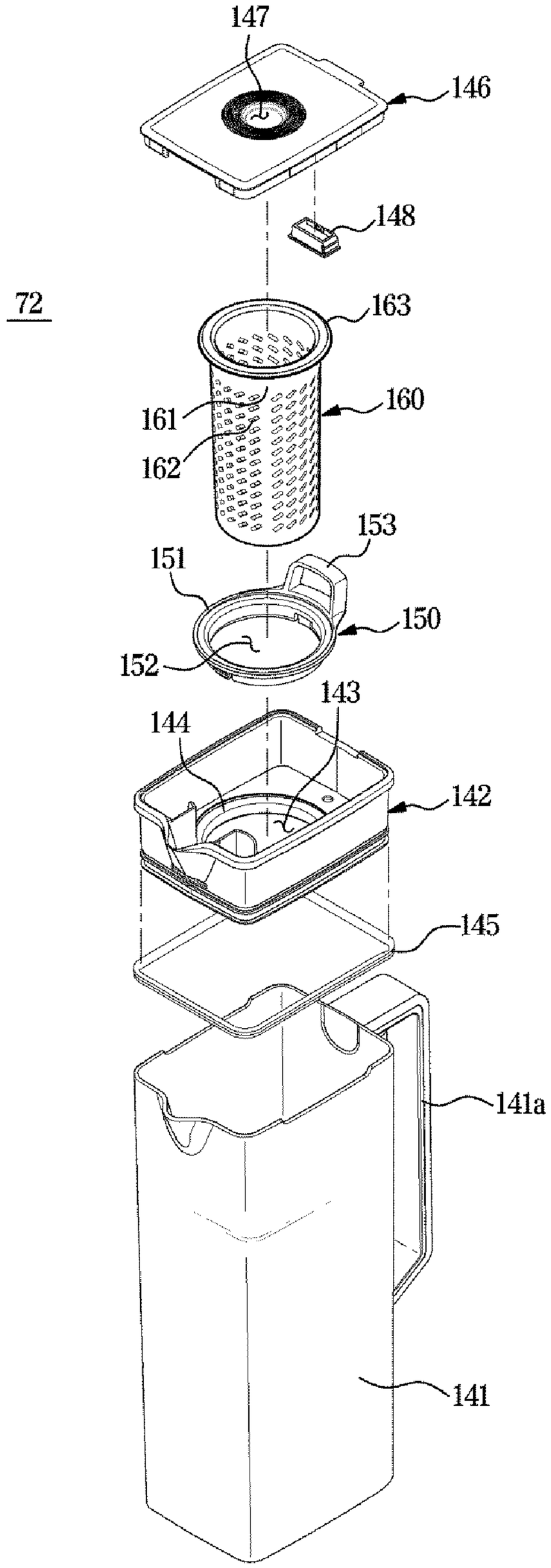
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FIG. 12

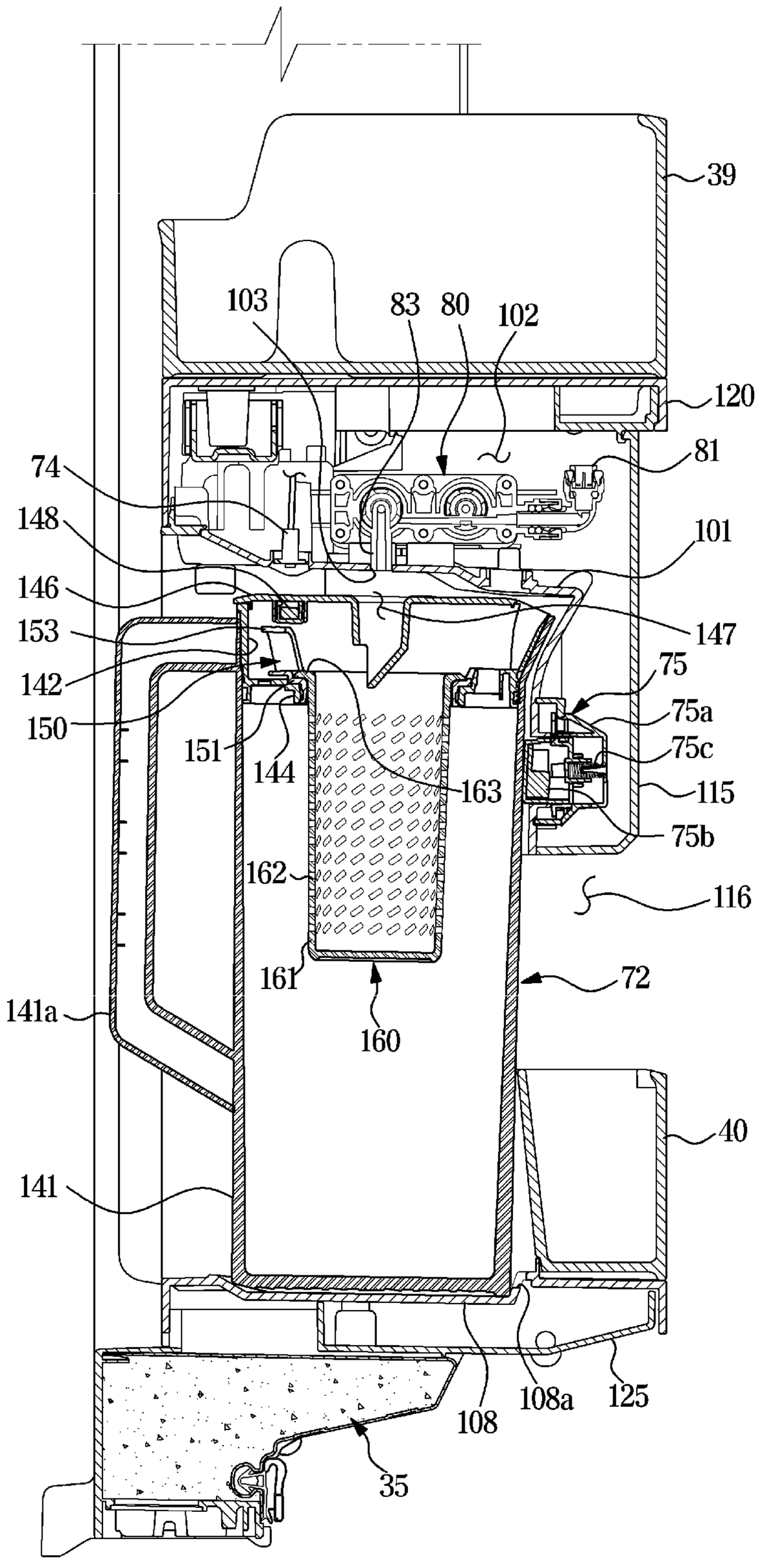
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FIG. 13

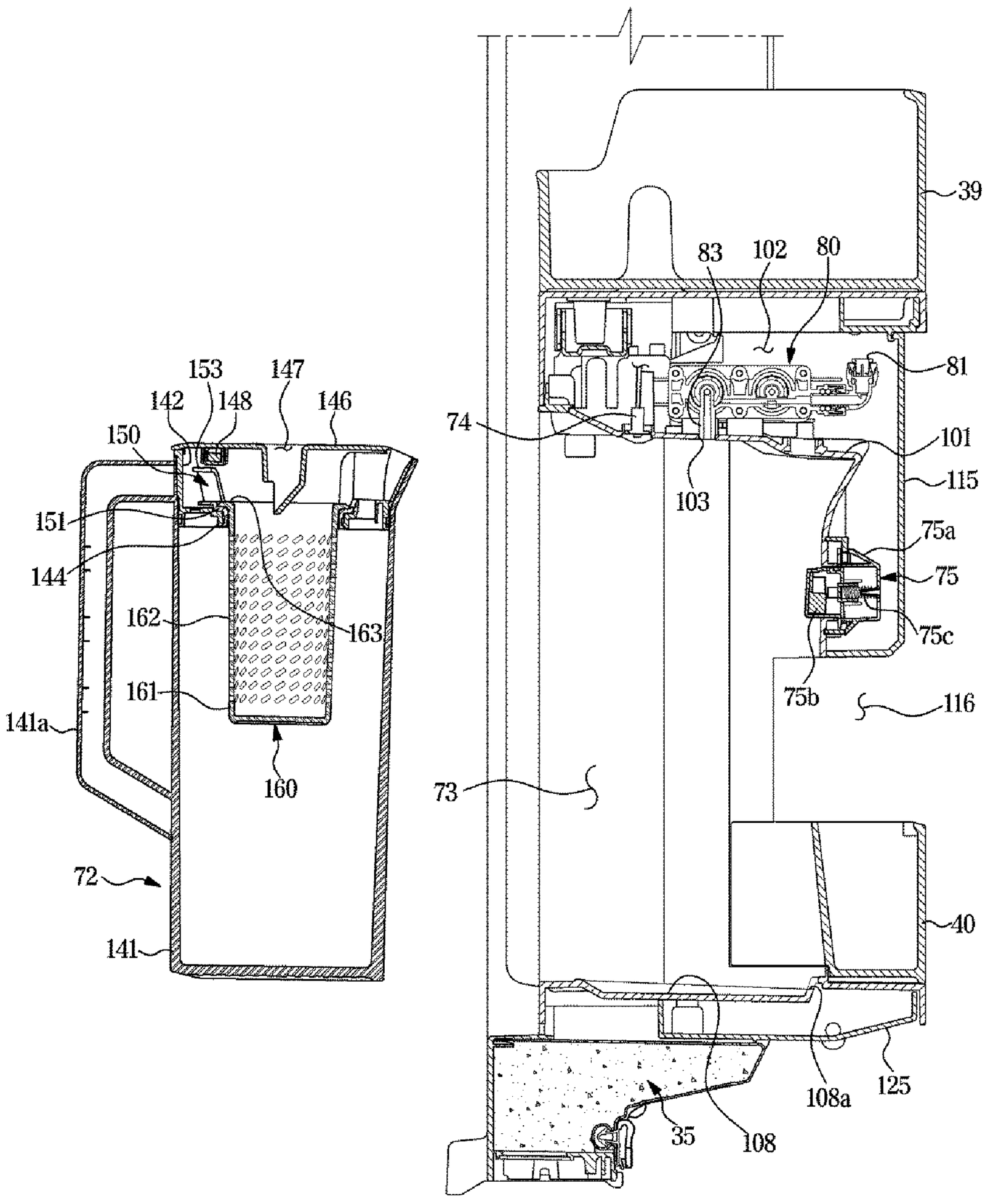
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FIG. 14

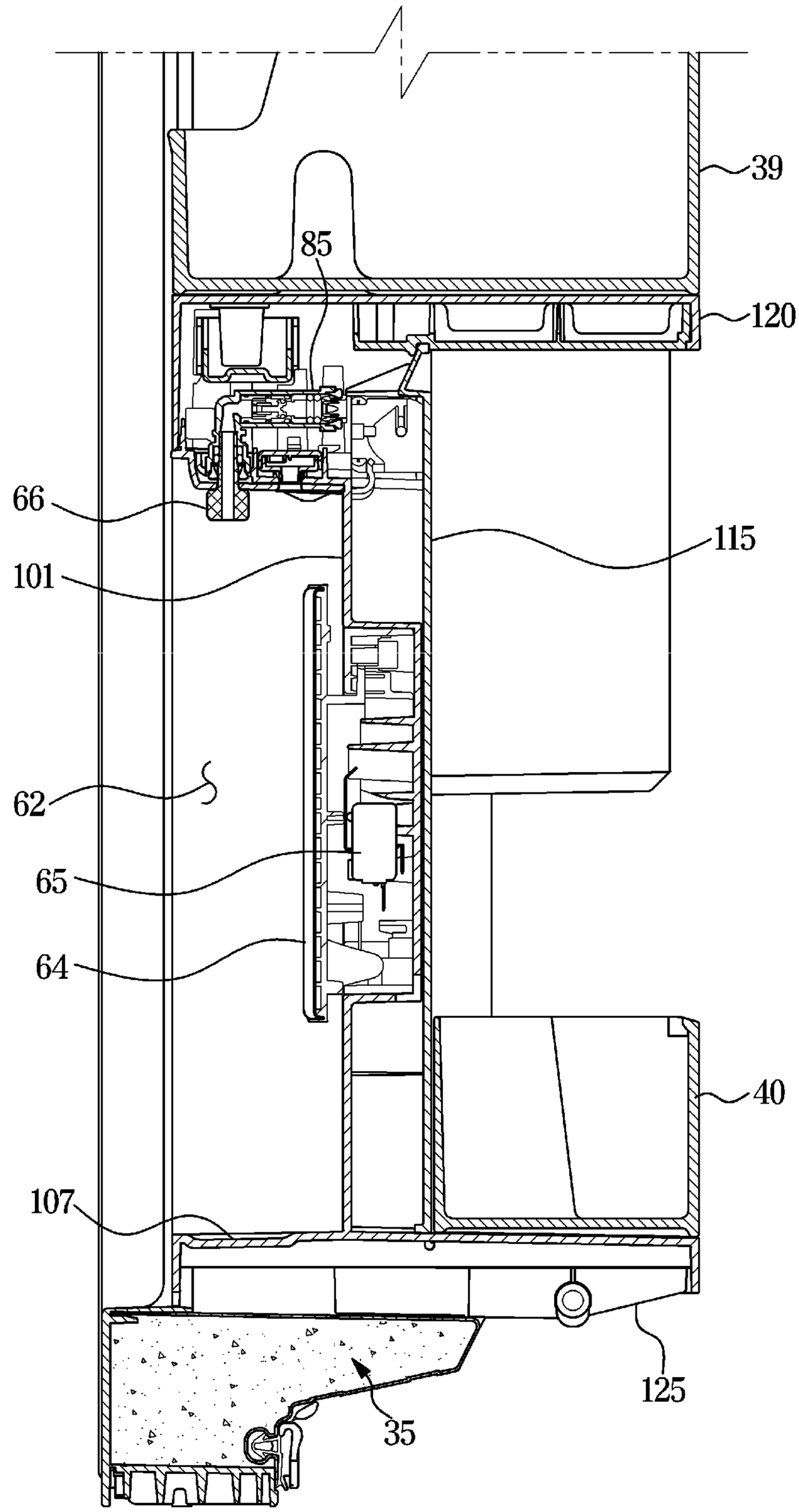


FIG. 15

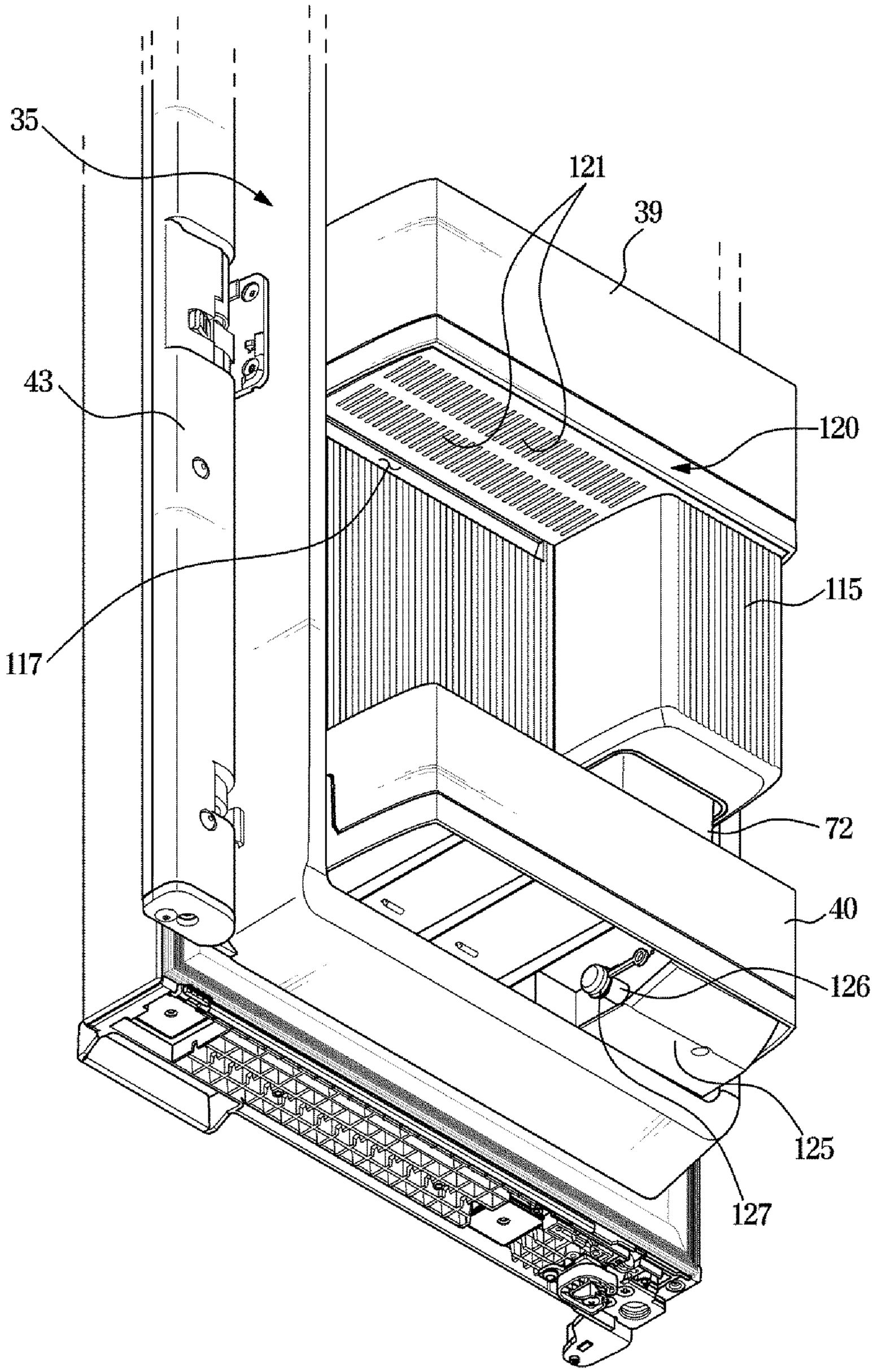


FIG. 16

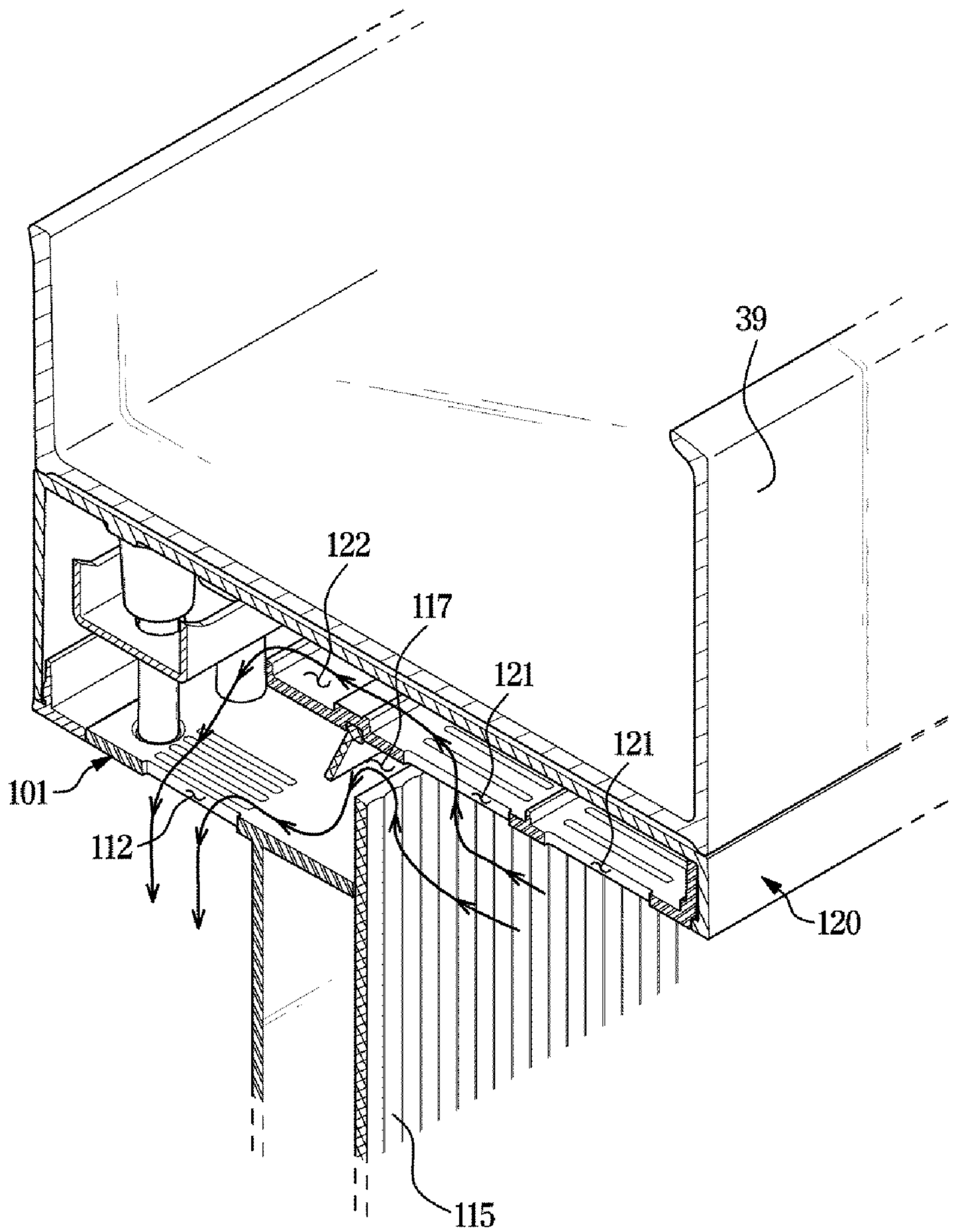


FIG. 17

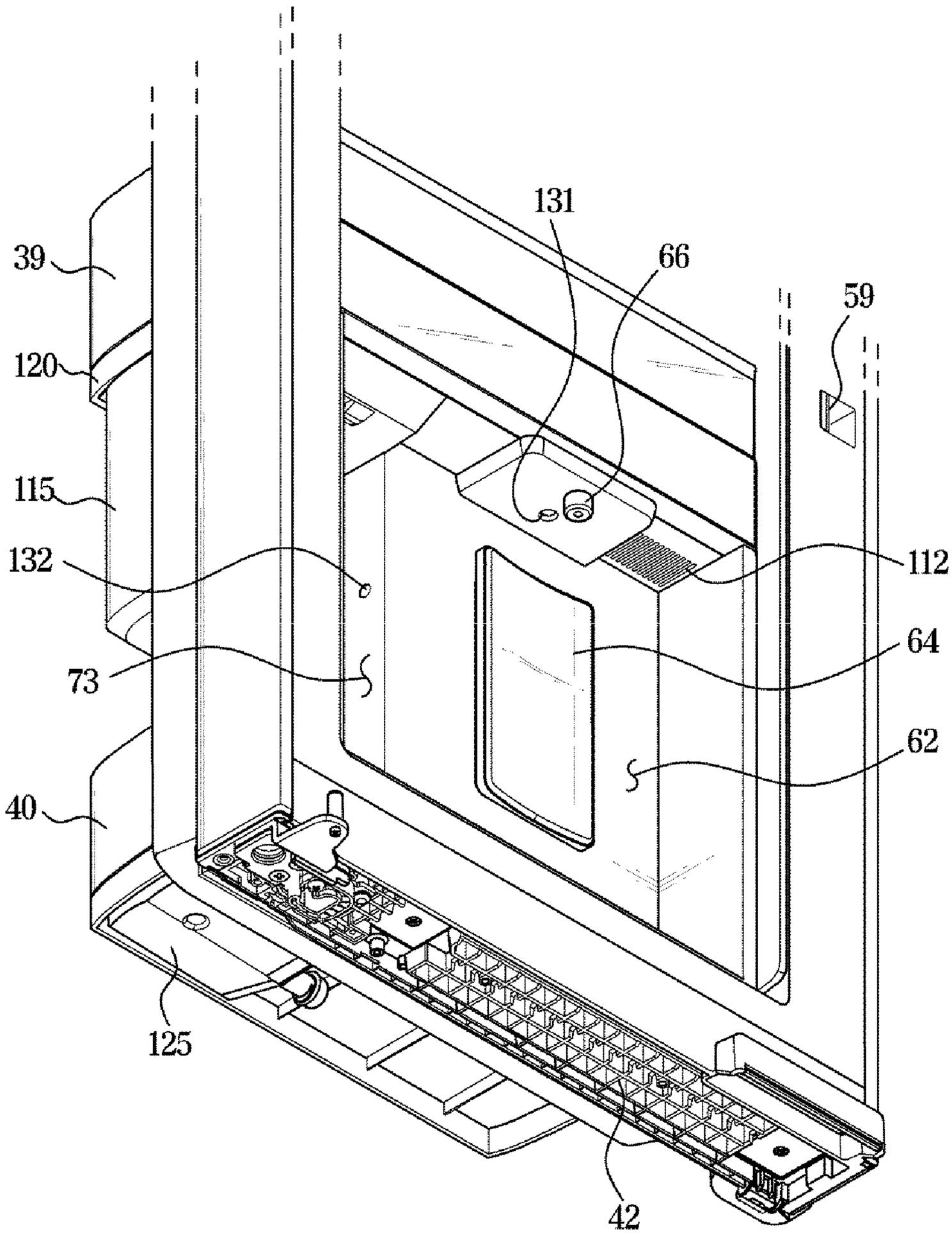


FIG. 18

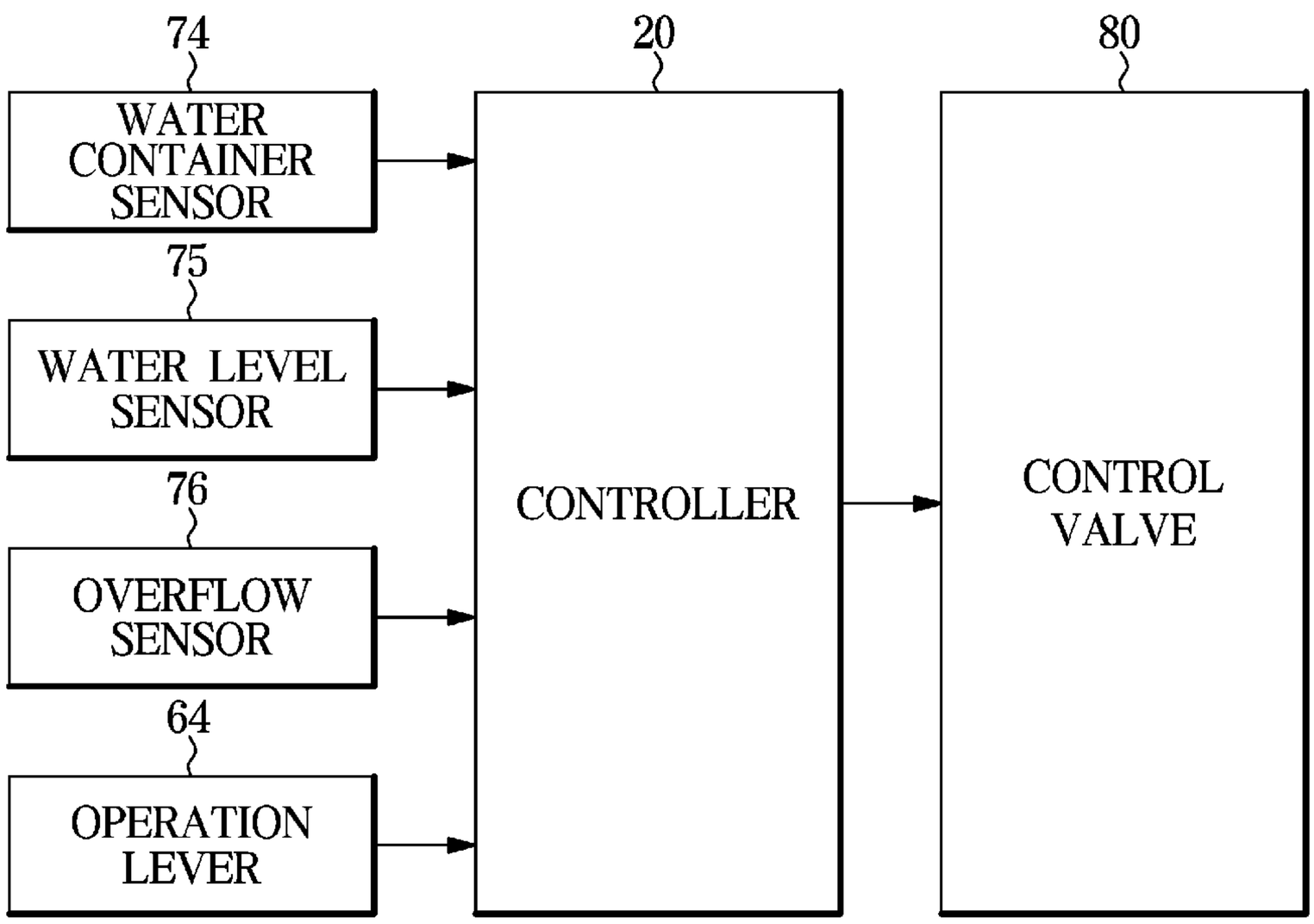

74
WATER CONTAINER SENSOR
75
WATER LEVEL SENSOR
76
OVERFLOW SENSOR
64
OPERATION LEVER
20
CONTROLLER
80
CONTROL VALVE

FIG. 19

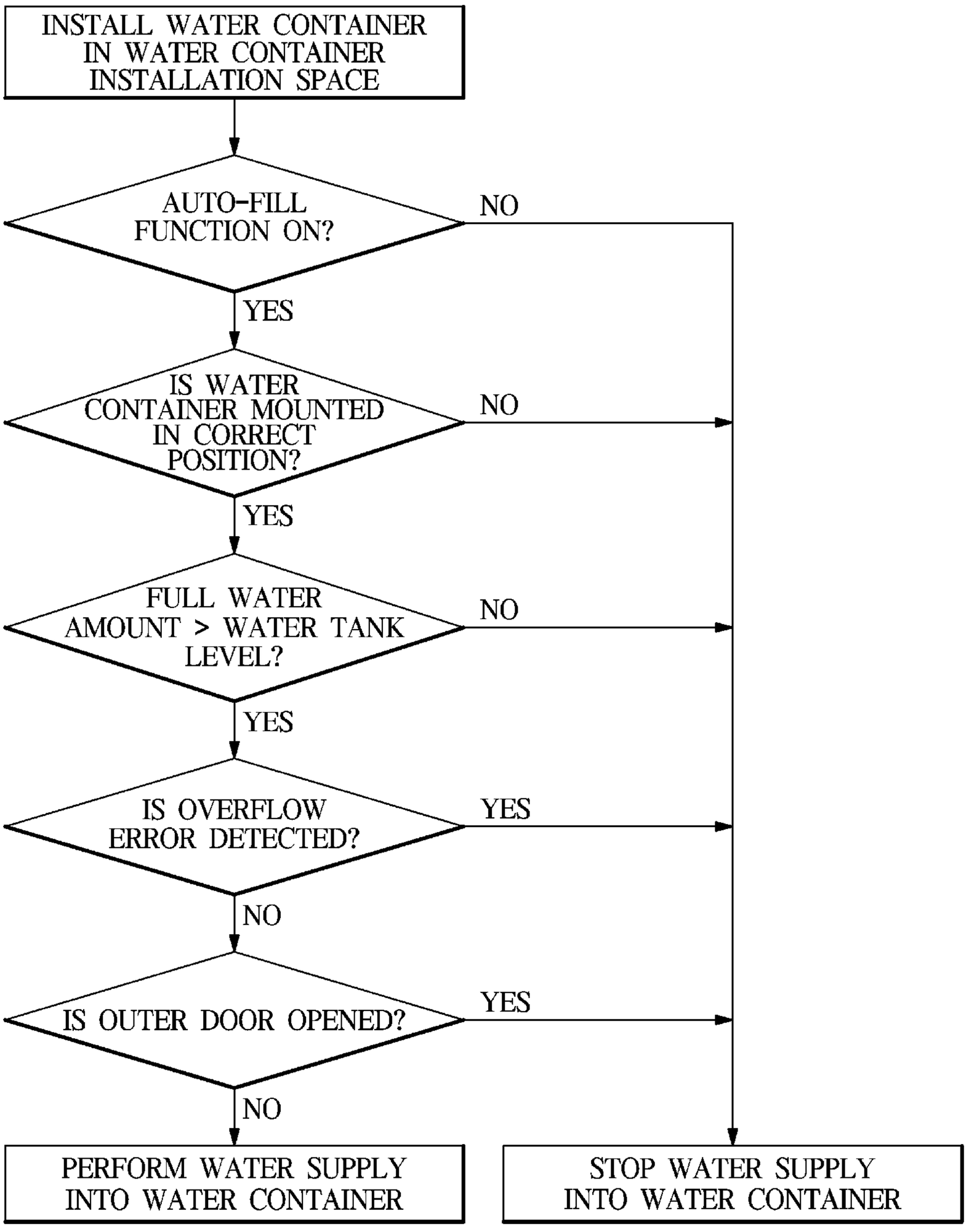

INSTALL WATER CONTAINER IN WATER CONTAINER INSTALLATION SPACE
AUTO-FILL FUNCTION ON?
NO
YES
IS WATER CONTAINER MOUNTED IN CORRECT POSITION?
NO
YES
FULL WATER AMOUNT > WATER TANK LEVEL?
NO
YES
IS OVERFLOW ERROR DETECTED?
YES
NO
IS OUTER DOOR OPENED?
YES
NO
PERFORM WATER SUPPLY INTO WATER CONTAINER
STOP WATER SUPPLY INTO WATER CONTAINER

FIG. 20

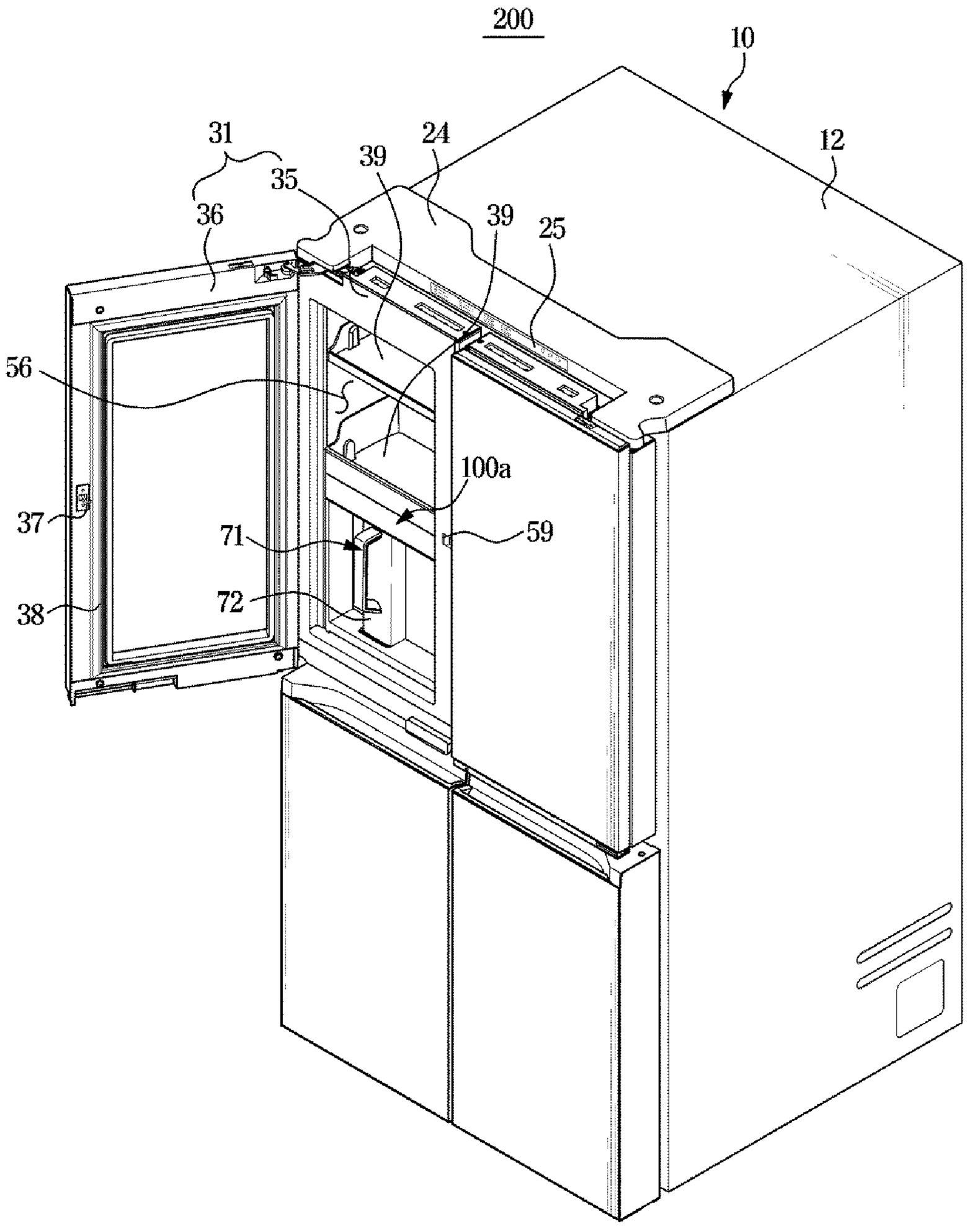


FIG. 21

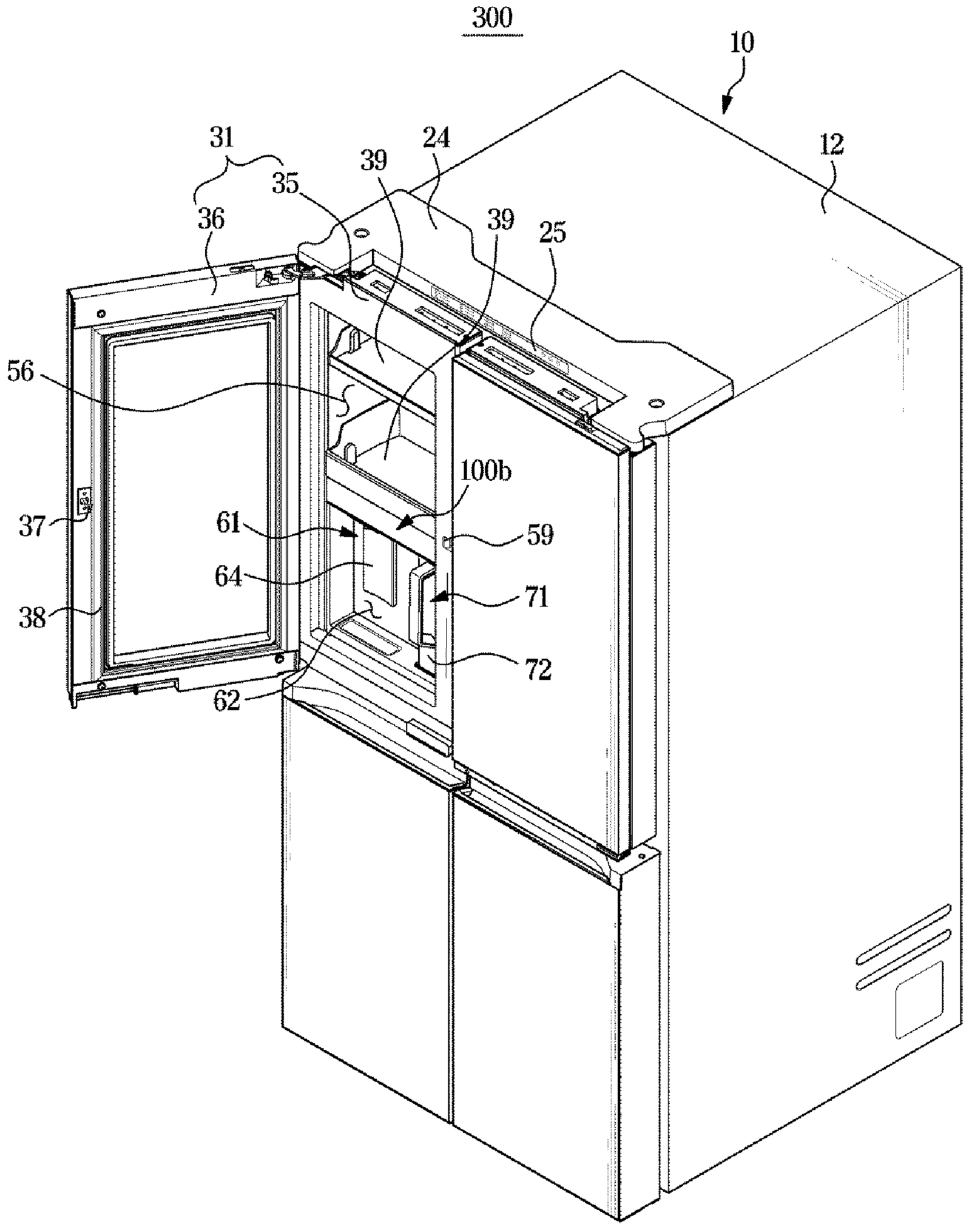


FIG. 22

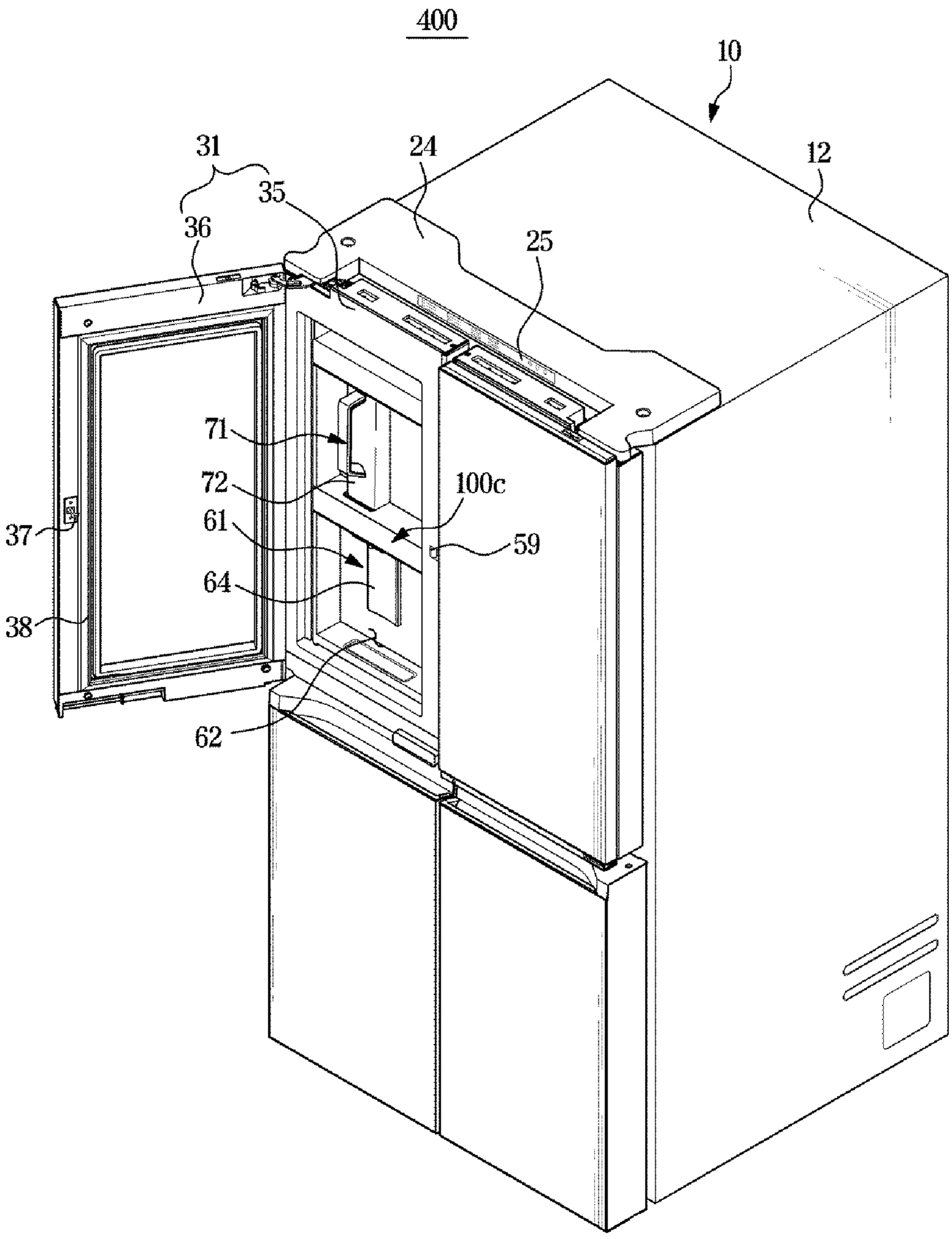
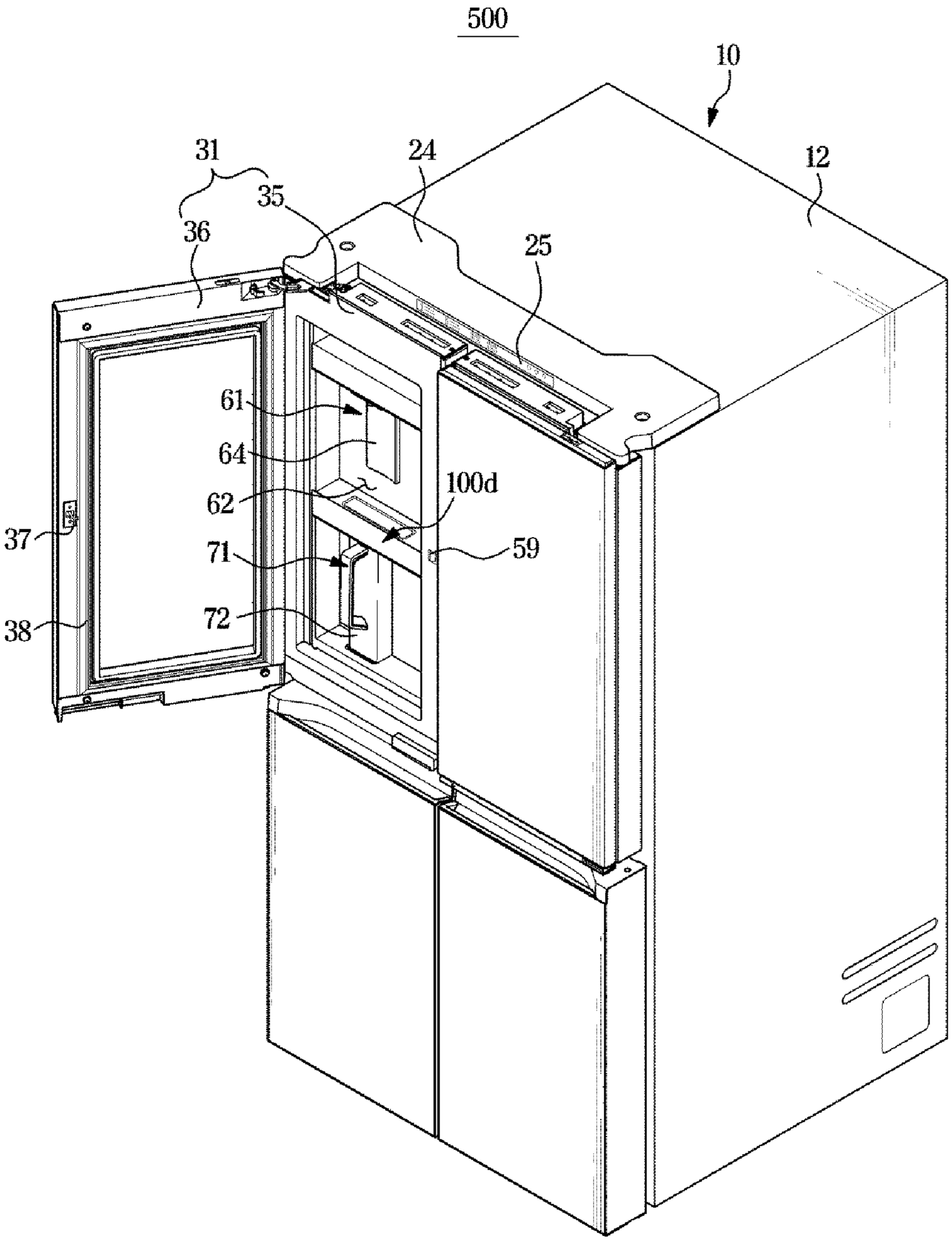


FIG. 23



REFRIGERATOR

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. application Ser. No. 17/570,960, filed on Jan. 7, 2022, which is a continuation application under 35 U.S.C. § 111(a), of international application No. PCT/KR2021/019918, filed on Dec. 27, 2021, which claims priority under 35 U. S. C. § 119 to Korean Patent Application No. 10-2021-0002864 filed on Jan. 8, 2021, the disclosures of each of which are incorporated herein by reference in its entirety.

1. FIELD

The disclosure relates to a refrigerator, and more particularly, to a refrigerator having a dispenser for supplying water by manipulation of an operation lever and an automatic water supplier for automatically supplying water to a water container when the water container is mounted.

2. BACKGROUND

Refrigerators are home appliances having a main body with storerooms and a cold air supply provided for supplying cold air into the storerooms, to keep food and groceries fresh.

Some refrigerators are equipped with a dispenser configured to supply water to the user from the outside of the refrigerator by manipulation of an operation lever without opening the door.

The dispenser may discharge water only when the user holds down the operation lever. This makes it hard for the user to get plenty of water at once, so the user has to keep pressure on the operation lever until as much water as required is gathered in the container.

SUMMARY

In accordance with an aspect of the disclosure, a refrigerator includes a main body having a storeroom; an inner door rotatably coupled to the main body; an outer door rotatably arranged in front of the inner door; a dispenser configured to supply water based on manipulation of an operation lever; and an automatic water supplier configured to supply water into a water container to fill the water container with a predetermined amount of water, the automatic water supplier including a water container installation space formed to have a water container mountable to the water container installation space, and a water level sensor configured to detect a water level of water in the water container, wherein the dispenser and the automatic water supplier are arranged at the inner door so that the dispenser and the automatic water supplier are accessible while the outer door is opened and the inner door is closed.

The refrigerator may further include a control valve configured to guide water supplied from an external water source to the dispenser or the automatic water supplier.

The control valve may include an inflow port to be connected to the external water source to receive the water; a first outflow port arranged to supply a portion of the water to the dispenser; and a second outflow port arranged to supply another portion of the water to the automatic water supplier.

The control valve may open or close the first outflow port based on the manipulation of the operation lever.

The control valve may open or close the second outflow port based on a detected water level in the water container.

The refrigerator may further include a tray arranged to receive water overflowing from the water container; and an overflow sensor configured to detect a water level of water in the tray, wherein the control valve may open or close the second outflow port based on a detected water level of the tray.

The refrigerator may further include a water supply case in which the operation lever and the water level sensor are installed and which forms the water container installation space.

The inner door may include door-inner sides forming a door-inside space and the door-inside space to be connected to the storeroom, and the water supply case may be mountable on the door-inner sides.

The water supply case may include a cut portion formed behind the water container installation space such that at least one side of a water container while the water container is mounted in the water container installation space is exposed to cold air of the storeroom.

The water supply case may include a valve installation space in which the control valve is mounted.

The water supply case may include a main case in which the water container installation space is formed; and a pair of reinforcing plates couplable onto respective sides of the main case to prevent the main case from being bent due to shrinkage deformation.

The water supply case may include a case bead formed for a door basket having a door-storage space to be mounted.

The water supply case may include an air hole formed at the water supply case so that cold air of the storeroom is supplied into the water container installation space.

The refrigerator may include a first lamp arranged in the water supply case to illuminate the operation lever, and a second lamp arranged in the water supply case to illuminate the water container.

In another aspect of the disclosure, a refrigerator may include a main body having a storeroom; an inner door rotatably coupled to the main body; an outer door rotatably arranged in front of the inner door; an automatic water supplier including a water container installation space formed to have a water container mounted and a water level sensor configured to detect a water level in the water container, and configured to automatically supply water into the water container to fill the water container with a certain amount of water; and a control valve configured to guide or block water supplied from an external water source to the automatic water supplier, wherein the automatic water supplier is arranged at the inner door so that the automatic water supplier is accessed while the outer door is open and the inner door is closed.

The control valve may control water supply into the water container according to a water level in the water container.

The automatic water supplier may include a water container sensor for detecting whether the water container is mounted in the water container installation space, and the control valve may control water supply into the water container based on whether the water container is mounted.

The refrigerator may further include a water supply case in which the water level sensor is installed and which forms the water container installation space.

The water supply case may include a valve installation space in which the control valve is mounted.

The water supply case may include a cut portion formed behind the water container installation space such that at

least one side of a water container mounted in the water container installation space is exposed to cold air of the storeroom.

DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present disclosure will become more apparent to those of ordinary skill in the art by describing in detail exemplary embodiments thereof with reference to the accompanying drawings, in which:

FIG. **1** is a perspective exterior view of a refrigerator, according to an embodiment of the disclosure;

FIG. **2** is a perspective view of a refrigerator with an outer door open, according to an embodiment of the disclosure;

FIG. **3** is a perspective view of a refrigerator with inner doors open, according to an embodiment of the disclosure;

FIG. **4** is a schematic diagram illustrating a water supply flow path of a refrigerator, according to an embodiment of the disclosure;

FIG. **5** illustrates an outer door and an inner door of a refrigerator, according to an embodiment of the disclosure;

FIG. **6** is an exploded view of an inner door of a refrigerator, according to an embodiment of the disclosure;

FIG. **7** illustrates a flow path structure of a water supply case of a refrigerator, according to an embodiment of the disclosure;

FIG. **8** is an exploded view of a water supply unit of a refrigerator, according to an embodiment of the disclosure;

FIG. **9** illustrates a structure of coupling between a water supply unit and an inner door of a refrigerator, according to an embodiment of the disclosure;

FIG. **10** illustrates a coupling structure of door baskets of a refrigerator, according to an embodiment of the disclosure;

FIG. **11** is an exploded view of a water container of a refrigerator, according to an embodiment of the disclosure;

FIG. **12** is a side cross-sectional view of an automatic water supplier of a refrigerator with a water container attached thereto, according to an embodiment of the disclosure;

FIG. **13** is a side cross-sectional view of an automatic water supplier of a refrigerator with a water container detached therefrom, according to an embodiment of the disclosure;

FIG. **14** is a side cross-sectional view of a dispenser of a refrigerator, according to an embodiment of the disclosure;

FIG. **15** is a perspective view of a rear side of an inner door of a refrigerator, according to an embodiment of the disclosure;

FIG. **16** is a cross-sectional view of a water supply case illustrating flows of cold air of a refrigerator, according to an embodiment of the disclosure;

FIG. **17** is a perspective front view of an inner door of a refrigerator, according to an embodiment of the disclosure;

FIG. **18** is a control block diagram of a refrigerator, according to an embodiment of the disclosure;

FIG. **19** is a flowchart illustrating a method of controlling water supply of a refrigerator, according to an embodiment of the disclosure;

FIG. **20** illustrates a refrigerator with an outer door open, according to another embodiment of the disclosure;

FIG. **21** illustrates a refrigerator with an outer door open, according to another embodiment of the disclosure;

FIG. **22** illustrates a refrigerator with an outer door open, according to another embodiment of the disclosure; and

FIG. **23** illustrates a refrigerator with an outer door open, according to another embodiment of the disclosure.

DETAILED DESCRIPTION

Various embodiments of the disclosure provide a refrigerator having an automatic water supplier for supplying water into a water container until the water container is filled with a certain amount of water once the water container is mounted.

Various embodiments of the disclosure provide a refrigerator that minimizes a leak of cold air when an automatic water supplier is accessed.

Various embodiments of the disclosure provide a refrigerator having an automatic water supplier with improved usability.

Various embodiments of the disclosure provide a refrigerator equipped with both a dispenser for supplying water by manipulation of an operation lever and an automatic water supplier for supplying water into a water container until the water container is filled with a certain amount of water once the water container is mounted.

Embodiments of the disclosure are only the most preferred examples and provided to assist in a comprehensive understanding of the disclosure as defined by the claims and their equivalents. Accordingly, those of ordinary skilled in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the disclosure.

It is to be understood that the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Throughout the specification, ordinal numbers used before components are used to distinguish the components from one another, and do not imply order of arrangement, manufacturing, or importance.

The terms "front", "rear", "upper", "lower", "top", and "bottom" as herein used are defined with respect to the drawings, but the terms may not restrict the shape and position of the respective components.

Reference will now be made in detail to embodiments of the disclosure with reference to accompanying drawings.

FIG. **1** is a perspective exterior view of a refrigerator, according to an embodiment of the disclosure. FIG. **2** is a perspective view of a refrigerator with an outer door open, according to an embodiment of the disclosure. FIG. **3** is a perspective view of a refrigerator with inner doors open, according to an embodiment of the disclosure. FIG. **4** is a schematic diagram illustrating a water supply flow path of a refrigerator, according to an embodiment of the disclosure.

Referring to FIGS. **1** and **4**, a refrigerator **1** may include a main body **10**, storerooms **21**, **22**, and **23** formed inside the main body **10**, doors **31**, **32**, **33**, and **34** to open or close the storerooms **21**, **22**, and **23**, and a cold air supply (not shown) for supplying cold air into the storerooms **21**, **22**, and **23**.

The main body **10** may include an inner case **11** that defines the storerooms **21**, **22**, and **23**, an outer case **12** coupled onto the outer side of the inner case **11** to define the exterior, and insulation (not shown) provided between the inner case **21** and the outer case **23** for insulating the storerooms **21**, **22**, and **23**.

There may be a horizontal partition wall **15** and a vertical partition wall **16** to separate the plurality of storerooms **21**, **22**, and **23**. The storerooms **21**, **22**, and **23** may be separated by the horizontal partition wall **15** into an upper storeroom **21** and the lower storerooms **22** and **23**, and by the vertical partition wall **16** into the lower left storeroom **22** and the lower right storeroom **23**.

The upper storeroom **21** may be used as a fridge, and the lower storerooms **22** and **23** may be used as freezers. How the storerooms **21**, **22**, and **23** are separated and used is not, however, limited thereto.

Furthermore, unlike this embodiment of the disclosure, there may be a side by side (SBS) type refrigerator having a storeroom partitioned by a vertical partition wall into left and right storerooms, a French door refrigerator (FDR) type refrigerator having a storeroom partitioned by a horizontal partition wall into upper and lower refrigeration chambers, or a one door type refrigerator having one storeroom and one door.

There may be shelves **26** on which to put groceries, and storage containers **27** for keeping groceries provided in the storerooms **21**, **22**, and **23**.

The cold air supply may produce cold air using a cooling cycle for compressing, condensing, and evaporating refrigerants, and supply the cold air to the storerooms **21**, **22**, and **23**.

The upper storeroom **21** may be opened or closed by a pair of doors **31** and **32**. The doors **31** and **32** may be rotatably coupled to the main body **10**. A filler **43** may be arranged at one of the pair of doors **31** and **32**, e.g., the door **31**, to prevent cold air of the storeroom **21** from leaking between the pair of doors **31** and **32** while the doors **31** and **32** are closed.

The lower left storeroom **22** may be opened or closed by a door **33**, which may be rotatably coupled to the main body **10**. The lower right storeroom **23** may be opened or closed by a door **34**, which may be rotatably coupled to the main body **10**.

The doors **31**, **32**, **33** and **34** may include door baskets **39** and **40** having door-storage space for storing groceries. Gaskets to be tight on the front side of the main body **10** to seal the storerooms **21**, **22**, and **23** may be provided on the rear side of the doors **31**, **32**, **33**, and **34**.

At least one of the doors **31**, **32**, **33** and **34** may be a double door comprised of an inner door **35** and an outer door **36**. For example, the upper left door **31** may include the inner door **35** and the outer door **36**.

The inner door **35** may be rotatably coupled to the main body **10** through a hinge. The inner door **35** may have a door-inside space **56**. The door-inside space **56** may be formed in a middle portion of the inner door **35** except edge portions. The door-inside space **56** may be formed to extend between the front side and the rear side of the inner door **35**. Accordingly, the door-inside space **56** may be connected to the storeroom **21** while the inner door **35** is closed.

The door baskets **39** and **40** may be installed in the door-inside space **56**.

A dispenser **61** may be arranged in the door-inside space **56**. The dispenser **61** may include an operation lever **64** to operate the dispenser **61** to supply water. The user may push the operation lever **65** with a container (not shown) such as a cup. The operation lever **64** may be movably installed in a lever installation part **110** formed at a water supply case **100**.

The dispenser **61** may further include a switch **65** (see FIG. **8**) to be turned on by the operation lever **64** when the operation lever **64** is pressed. The dispenser **61** may include a dispenser nozzle **66** (see FIG. **7**) through which to discharge water. The dispenser nozzle **66** may be installed at the water supply case **100**.

The dispenser **61** may include a water-intake space **62** in which a container to receive water discharged from the dispenser nozzle **66** may be placed. The water-intake space **62** may be hollowed out of the front of the water supply case **100**. However, unlike this embodiment of the disclosure, the water-intake space **62** may not be provided when the dispenser nozzle **66** is formed to protrude forward from the water supply case **100**.

In the door-inside space **56**, there may be an automatic water supplier **71** arranged to include a water container installation space **73** (see FIG. **7**) in which to install a water container **72** and a water level sensor **75** for detecting a water level in the water container **72** when the water container is mounted in the water container installation space **73**. The automatic water supplier **71** may include an outlet through which to supply water into the water container **72** mounted in the water container installation space **73**.

In an embodiment of the disclosure, the outlet may be implemented as a second outflow port **83** of a control valve **80**. However, unlike this embodiment of the disclosure, the outlet may be implemented as a separate part instead of the second outflow port **83** of the control valve **80**. In this case, the outlet may be connected to the second outflow port **83** through a separate flow path.

The automatic water supplier **71** may automatically supply water into the water container **72** so that the water container **72** is filled with a certain amount of water when the water container **72** is mounted in the water container installation space **73**. In other words, the automatic water supplier **71** may perform an auto-fill function. The certain amount of water may correspond to an almost full water amount for the water container **72**.

The water container installation space **73** may be hollowed out of the front of the water supply case **100**. The water-intake space **62** and the water container installation space **73** may be connected to each other. The water supply case **100** may be installed in the door-inside space **56**.

The water level sensor **75** may be installed in the water supply case **100**. An outlet may be installed at the water supply case **100**.

As described above, the operation lever **64**, the switch **65**, and the dispenser nozzle **66** of the dispenser **61** may be installed or supported at the water supply case **100**, and the water level sensor **75** and the outlet of the automatic water supplier **71** may be installed or supported at the water supply case **100**. Furthermore, the water container installation space **73** of the automatic water supplier **71** may be defined by the water supply case **100**.

Accordingly, the dispenser **61**, the automatic water supplier **71**, and the water supply case **100** may be provided in a single assembly. In the disclosure, such an assembly may be referred to as a water supply unit **60**.

The water supply unit **60** may be arranged in the door-inside space **56** of the inner door **35**. Specifically, the water supply case **100** of the water supply unit **60** may be mounted on door-inner sides **55** that define the door-inside space **56**.

As described above, when the inner door **35** is closed, the door-inside space **56** is connected to the storeroom **21**, so that the water supply unit **60** may be cooled by cold air of the storeroom **21**. Furthermore, the water-intake space **62** and the water container installation space **73** may be formed on the front of the water supply case **100**. Accordingly, the

water-intake space **62** and the water container installation space **73** may be accessed while the inner door **35** is closed.

The outer door **36** may be arranged to open or close the door-inside space **56** of the inner door **35**. A gasket **38** may be provided on the rear side of the outer door **36** to seal the door-inside space **56**. The gasket **38** may be tight on a front surface of the inner door **35** around the door-inside space **56**.

When the outer door **36** is opened, the door-inside space **56** of the inner door **35** may be accessed. The outer door **36** may be rotatably coupled to the inner door **36** through a hinge **44** (see FIG. **5**). The outer door **36** may be turned in the same direction as the inner door **35**. The outer door **36** may have a size corresponding to the size of the inner door **35**. The outer door **36** may cover the whole area of the inner door **35**.

A latch **37** may be arranged at the outer door **36** to be fastened to the inner door **35**, and a catch **59** may be arranged at the inner door **35** to interlock with the latch **37**. When the outer door **36** is opened while the latch **37** and the catch **59** are interlocked, the outer door **36** and the inner door **35** are opened together, and when the outer door **36** is opened while the latch **37** and the catch **59** are not interlocked, the outer door **36** may be opened while the inner door **35** is not opened.

A decoration panel (not shown) may be detachably coupled onto the front side of the outer door **36**.

A top cover **24** may be coupled onto the top side of the main body **10**. The top cover **24** may be provided to cover the hinge and many different electronic parts arranged on the top of the main body **10**. A control panel **25** for displaying various states and operation information of the refrigerator **1** or entering various commands for operation of the refrigerator **1** may be arranged on the front side of the top cover **24**.

As described in FIG. **4**, the refrigerator **1** may include a purifying filter **91** and a water tank **93**. The purifying filter **91** may purify water supplied from an external water source **90**. The water tank **93** may store water purified by the purifying filter **91**. The water tank **93** may be cooled by cold air of the storeroom **21**.

An ice maker **23** for forming ice may be arranged in the storeroom **22** of the refrigerator **1**. The ice maker **23** may form ice by using the cold air of the storeroom **22**.

The refrigerator **1** may include a water supply flow path **97** that forms a flow path connecting the external water source **90** to the control valve **80** to supply water to the dispenser **61** and the automatic water supplier **71**, and an ice maker flow path **96** connecting the external water source **90** to the ice maker **23** to supply water to the ice maker **23**.

The ice maker flow path **96** and the water supply flow path **97** may be formed to branch off from a point at which a flow path switching valve **92** may be arranged to supply water supplied from the external water source **90** selectively to the control valve **80** or the ice maker **23**. The water from the external water source **90** may be supplied to the control valve **80** or the ice maker **28** based on water pressure of the external water source **90** and under the control of the flow path switching valve **92**.

The water supply flow path **97** may be arranged to go through the purifying filter **91**. Accordingly, the water from the external water source **90** may be purified through the purifying filter **81** and supplied to the control valve **90**. The water supply flow path **97** may be arranged to go through the water tank **93**. Accordingly, the water from the external water source **90** may be cooled in the water tank **93** and then supplied to the control valve **80**.

A water valve **94** may be arranged in the water supply flow path **97**. The water valve **94** may control an amount of water to be supplied to the control valve **80** from the water tank **93**. A flow sensor **95** may be arranged in the water supply flow path **97** for measuring an amount of water supplied to the control valve **80**.

The ice maker flow path **96** may be arranged to go through the purifying filter **91**. Accordingly, the water from the external water source **90** may be purified through the purifying filter **81** and supplied to the ice maker **23**. The ice maker flow path **96** may not go through the water tank **93** because the water to be supplied to the ice maker **28** is cooled in the ice maker **28** even though not cooled in the water tank **93**.

FIG. **5** illustrates an outer door and an inner door of a refrigerator, according to an embodiment of the disclosure. FIG. **6** is an exploded view of an inner door of a refrigerator, according to an embodiment of the disclosure. FIG. **7** illustrates a flow path structure of a water supply case of a refrigerator, according to an embodiment of the disclosure. FIG. **8** is an exploded view of a water supply unit of a refrigerator, according to an embodiment of the disclosure. FIG. **9** illustrates a structure of coupling between a water supply unit and an inner door of a refrigerator, according to an embodiment of the disclosure. FIG. **10** illustrates a coupling structure of door baskets of a refrigerator, according to an embodiment of the disclosure. FIG. **11** is an exploded view of a water container of a refrigerator, according to an embodiment of the disclosure. FIG. **12** is a side cross-sectional view of an automatic water supplier of a refrigerator with a water container attached thereto, according to an embodiment of the disclosure. FIG. **13** is a side cross-sectional view of an automatic water supplier of a refrigerator with a water container detached therefrom, according to an embodiment of the disclosure. FIG. **14** is a side cross-sectional view of a dispenser of a refrigerator, according to an embodiment of the disclosure. FIG. **18** is a control block diagram of a refrigerator, according to an embodiment of the disclosure. FIG. **19** is a flowchart illustrating a method of controlling water supply of a refrigerator, according to an embodiment of the disclosure.

Referring to FIGS. **5** to **10**, the inner door **35** may include a front plate **51**, a rear plate **53**, an upper cap **41**, and a lower cap **42**. A foaming space may be formed between the front plate **51**, the rear plate **53**, the upper cap **41**, and the lower cap **42**, and insulation (not shown) may be arranged in the foaming space. Urethane foam insulation may be used for the insulation. In addition, for the insulation, vacuum insulation may also be used with the foam insulation.

The front panel **51** may form the front and both sides of the inner door **35**. The front panel **51** may include a front panel opening **51***a* corresponding to the front panel **51** except for edge portions.

The catch **59** may be arranged on the front panel **51** to interlock with the latch **37** of the outer door **36**.

The rear panel **53** may include the door-inside space **56** formed in the middle of the rear plate **53** except for edge portions. The rear panel **53** may include door-inner sides **55** that define the door-inside space **56**. The door-inner sides **55** may be formed on top, bottom, left and right sides of the door-inside space **56** to define the door-inside space **56**. However, unlike this embodiment of the disclosure, the door-inner sides **55** may be formed by the front panel **51** or may be formed by both the front panel **51** and the rear panel **53**.

First door beads **57** may be formed on the door-inner side **55** to protrude from the door-inner side **55** toward the

door-inside space **56** in order for the door basket **39** to be mounted. The door basket **39** may be mounted on the door-inner sides **55** through the first door beads **57**.

A second door bead **58** may be formed on the door-inner side **55** to protrude from the door-inner side **55** toward the door-inside space **56** in order for the water supply case **100** to be mounted. The water supply case **100** may be mounted on the door-inner sides **55** through the second door bead **58**. A fastening hole **55***b* may be formed on the door-inner side **55** for the water supply unit **60** to be coupled through a fastening member Si (see FIG. **9**).

A through-port **55***a* through which wires and hoses connected to the water supply unit **60** pass may be formed on the door-inner side **55**. The water supply flow path **97** passing through a hinge shaft on the top of the inner door **35** and then inserted to the inner door **35** may be guided to the water supply case **100** through a flow path guide **97***a* (see FIG. **6**) and the through-port **55***a*.

Referring to FIG. **8**, the water supply case **100** may include a main case **101**, a rear case **115** coupled onto the back of the main case **101**, a case cover **120** coupled onto the top of the main case **101**, and a tray **125** coupled to the bottom of the main case **101**.

The water-intake space **62** and the water container installation space **73** may be formed on the front of the main case **101**. The water-intake space **62** and the water container installation space **73** may be formed side by side in the horizontal direction. The water-intake space **62** and the water container installation space **73** may be connected to each other.

On the bottom of the main case **101**, there may be a container pedestal **107** to support a container that receives water discharged into the intake space **62**, and a water container pedestal **108** to support the water container **72** that receives water discharged through the automatic water supplier **71**.

The main case **101** may include a lever installation part **110** in which the operation lever **64** of the dispenser **61** is mounted, and a switch **65** that is turned on or off depending on the position of the operation lever **64** may be arranged in the lever installation part **110**.

A reinforcing member **111** may be coupled onto either side of the main case **101** to prevent shrinkage deformation of the main case **101** due to cooling. The reinforcing member **111** may be formed of an iron plate material. The reinforcing member **111** may be arranged vertically to be long on either side of the main case **101**.

A valve installation space **102** (see FIG. **8**) may be formed on the top side of the main case **101**. The control valve **80** may be mounted in the valve installation space **102**, and the case cover **120** coupled onto the top of the main case **101** may prevent the control valve **80** from being exposed to the outside. That is, the valve installation space **102** may be formed between the main case **101** and the case cover **120**. The case cover **120** may be coupled onto the top of the main case **101** through a fastening member such as a screw. For this, a coupling hole **123** may be formed at the case cover **120** to be coupled with the fastening member.

The control valve **80** may guide water supplied from the external water source **90** through the water supply flow path **97** to the water-intake space **62** or the water container **72**. The control valve **80** may be shaped like a three-way valve. Specifically, the control valve **80** may include an inflow port **81** connected to the water supply flow path **97** to receive water from the external water source **90**, a first outflow port **82** for supplying water toward the water-intake space **62**, and a second out-flow port **83** for supplying water toward the water container **72**. The first and second outflow ports **82** and **83** may be selectively opened or closed.

Referring to FIG. **7**, the water supply flow path **97** guided into the water supply case **100** through the through-port **55***a* may be connected to one end of a first fitting member **84**. The other end of the first fitting member **84** and the inflow port **81** of the control valve **80** may be connected by a connection flow path **98**. However, unlike this embodiment of the disclosure, the first fitting member **84** may be omitted and the water supply flow path **87** may be directly connected to the inflow port **81** of toe control valve **80**.

The first outflow port **82** of the control valve **80** may be connected to one end of a second fitting member **85** arranged on the top side of the main case **101** through a second connection flow path **99**. The other end of the second fitting member **85** may be coupled to the dispenser nozzle **66**. The dispenser nozzle **66** may be detachably coupled to the other end of the second fitting member **85**.

The second outflow port **83** may be formed to protrude downward from the control valve **80**. The second outflow port **83** may be placed in a valve through-hole **103** formed at the top side of the main case **101**. The water discharged from the second outflow port **83** may fall in a direction of gravity and flow directly into an inlet **147** of the water container **72** without an extra connection member (see FIG. **12**). Accordingly, as described above, the second outflow port **83** may be referred to as an outlet of the automatic water supplier **71**.

The refrigerator **1** may include a water container sensor **74** for detecting whether the water container **72** is mounted in the water container installation space **73**. The control valve **80** may be configured to block water from being supplied into the water container **72** when the water container sensor **74** detects that the water container **72** has not been mounted in the water container installation space **73**. In other words, the control valve **80** may be configured to allow water to be supplied into the water container **72** when the water container **72** is mounted in the water container installation space **73**.

The control valve **80** may be configured to block water from being supplied into the water container **72** when the water level sensor **75** detects that a certain amount of water has been stored in the water container **72**. On the other hand, the control valve **80** may be configured to allow water to be supplied into the water container **72** when the water level sensor **75** detects that the certain amount of water has not been stored in the water container **72**. That is, the control valve **80** may be configured to open or close the second outflow port **83** based on the water level in the water container **72** detected by the water level sensor **75**.

The control valve **80** may be configured to block water from being supplied into the water container **72** when an overflow sensor **76** detects that a certain amount of water has been collected in the tray **125**.

The control valve **80** may open the first outflow port **82** that supplies water toward the water-intake space **62** when a certain signal is input to the operation lever **64**.

The tray **125** may be arranged underneath the main case **101**. The tray **125** may store water flowing out of the water container **72** mounted in the water container installation space **73**. Specifically, the tray **125** may collect water overflowing from the water container **72** when water is overly supplied into the water container **72** and overflows out of the water container **72**.

When the water overflows from the water container **72**, the water overflowing from the water container **72** may be guided to the tray **125** through an overflow hole **108***a* of the main case **101**.

The overflow sensor **76** may be arranged at the tray **125** to detect water collected in the tray **125**. When detecting that a certain amount of water has been collected in the tray **125**, the overflow sensor **76** may send the controller **20** a signal to control the control valve **80** to block water from being supplied into the water container **72**.

A drain hole **126** may be formed at the tray **125** to drain out the water collected in the tray **125**. A stopper **127** may be mounted in the drain hole **126** to open or close the drain hole **126**. The stopper **127** may be provided to close the drain hole **126** in ordinary times, and when the stopper **127** is detached from the drain hole **126**, the water collected in the tray **125** may be discharged to the outside.

The water container sensor **74** may be arranged on the top of the main case **101** to detect whether the water container **72** is mounted. The water container sensor **74** may be configured with a hall sensor. The water container sensor **74** may detect a magnet **148** (see FIG. **12**) equipped in the water container **72**. The water container sensor **74** may be covered by the case cover **120** and may not be exposed to the outside.

The water container sensor **74** may detect whether the water container **72** is mounted in the water container installation space **73** of the water supply case **100**, and send the controller **20** a signal to control the control valve **80** to block water from being supplied into the water container **72** when the water container **72** is not mounted. Accordingly, water may be prevented from being supplied into the water container **72** while the water container **72** is not properly mounted.

As described above, the main case **101** may be arranged in the door-inside space **56** of the inner door **35**. Specifically, the main case **101** may be coupled onto the door-inner sides **55** that define the door-inside space **56**. For this, a bead groove **106** may be formed on either side of the main case **101**. The man case **101** may be arranged in the door-inside space **56** of the inner door **35** in such a manner that the second door bead **58** of the inner door **35** is inserted to the bead groove **106**.

In order for the main case **101** to be securely coupled to the door-inside space **56** of the inner door **35**, the main case **101** may be coupled to the inner door **35** through the fastening member **51** such as a screw. For this, a coupling hole **105** to be coupled with the fastening member **51** may be arranged at the main case **101**, and a fastening hole **55***b* to be coupled with the fastening member **51** may be formed at the door-inner side **55** of the inner door **35**. The main case **101** may include a coupling bracket **104** that protrudes upward, and the coupling hole **105** may be formed at the coupling bracket **104**.

With this structure, the main case **101** may be coupled with the inner door **35** in such a manner that the second door bead **58** of the inner door **35** is inserted to the bead groove **106** of the main case **101** and then the fastening member **51** is fastened to the coupling hole **105** of the main case **101** and the fastening hole **55***b* of the inner door **35**. On the contrary, the main case **101** may be separated from the inner door **35** by separating the fastening member **51** and decoupling the second door bead **58** from the bead groove **106**.

The water supply case **100** may include a rear case **115** to be coupled to the back of the main case **101**. The rear case **115** may define a rear appearance of the water supply unit **60**. The rear case **115** may include a cut portion **116** formed by cutting a portion of the rear case **115** located behind the water container installation space **73**. At least one side of the water container **72** mounted in the water container installation space **73** may be exposed through the cut portion **116**. Hence, the water container **72** may be easily cooled by cold air of the storeroom **21**.

The water level sensor **75** may be arranged between the main case **101** and the rear case **115**.

The water level sensor **75** may be coupled to the rear surface of the main case **101**. The position of the water level sensor **75** is not, however, limited thereto, and the water level sensor **75** may be arranged in any position that allows detection of the water level in the water container **72**.

The water level sensor **75** may correspond to a capacitance sensor capable of detecting the water level in the water container **72** by detecting capacitance that changes by water level in the water container **72**. The water level sensor **75** is able to detect the water level in the water container **72** without directly contacting a liquid in the water container **72**, thereby having a relatively simple configuration and obtaining a relatively accurate detection result.

The water level sensor **75** may detect the water level in the water container **72** while in contact with the water container **72**. For this, the water level sensor **75** may include a sensor bracket **75***a* fixed to the main case **101**, a sensor part **75***b* for detecting the water level in the water container **72**, and an elastic member **75***c* for pressing the sensor part **75***b* against the water container **72**.

The sensor part **75***b* may be arranged to come into contact with the water container **72** when the water container **72** is mounted in the water container installation space **73**. The sensor part **75***b* may be arranged to be movable forward or backward relative to the sensor bracket **75***a*.

When a certain amount of water is stored in the water container **72**, the water level sensor **75** may send the controller **20** a signal to control the control valve **80** to block water from being supplied into the water container **72**. On the other hand, when the water container **72** is filled with less than the certain amount of water, the water level sensor **75** may send the controller **20** a signal to control the control valve **80** to perform water supply into the water container **72**.

Referring to FIG. **10**, the door baskets **39** and **40** may include the door basket **39** mounted on the first door bead **57** of the inner door **35** and the door basket **40** mounted on the case bead **109** of the water supply case **100**.

A bead groove **39***a* may be formed at either side of the door basket **39**, and the door basket **39** may be mounted at the inner door **35** by inserting the first door bead **57** to the bead groove **39***a*.

A bead groove **40***a* may be formed at either side of the door basket **40**, and the door basket **40** may be mounted at the water supply case **100** by inserting the case bead **109** of the water supply case **100** to the bead groove **40***a*.

Referring to FIG. **11**, the water container **72** may include a water container body **141** for storing water, a water container middle cover **142** coupled onto the top of the water container body **141**, a water container top cover **146** coupled onto the top of the water container middle cover **142**, an infuser **160** for containing e.g., a tea bag, and an infuser ring **150** for easily attaching or detaching the infuser **160** to or from the water container middle cover **142**.

The water container body **141** may store a certain amount of water. A maximum amount of water to be stored in the water container body **141** may be called a full water amount. The water container body **141** may be formed with a transparent material for the water stored inside to be checked. The water container body **141** may include a water

container handle **141***a* formed for the user to easily grip to mount or demount the water container body **141** in or from the water container installation space **73**.

The water container middle cover **142** may be coupled with the water container body **141** by forced fitting. The water container middle cover **142** may include a cover opening **143** to which the infuser **160** is inserted. A ring supporter **144** may be formed around the cover opening **143** for a ring part **151** of the infuser ring **150** to be seated thereon. The water container middle cover **142** may have open top for the infuser **160** to be easily mounted.

A sealing member **145** may be arranged between the water container body **141** and the water container middle cover **142** to prevent a leak of the water stored in the water container body **141**. The sealing member **145** may be formed of an elastic material such as rubber.

The water container top cover **146** may be provided to cover the open top of the water container middle cover **142**. The water container top cover **146** may include an inlet **147** through which water flows into the water container body **141**. When the water container **72** is mounted in the water container installation space **73**, the inlet **147** may be positioned to match the valve through-hole **103** formed at the top of the main case **101** and the second outflow port **83** of the control valve **80** (see FIG. **11**).

A magnet **148** may be arranged at the water container top cover **146**. The magnet **148** may be arranged in a position matching the water container sensor **74** when the water container **72** is mounted in the water container installation space **73**.

The infuser **160** may include a filter **161** formed to contain e.g., a tea bag. The filter **161** may have a circular form. Through holes **162** may be formed at the filter **161** to pass water through the filter **161**. A rim **163** may be formed at the top end of the filter **161** to protrude outward in the radial direction.

The infuser ring **150** may include a ring part **151** having a ring opening **152** to which the infuser **160** is inserted, and a ring handle **153** protruding from the ring part **151**. When the infuser **150** is inserted down to the ring opening **162** of the infuser ring **150**, the lower side of the rim **163** of the infuser **160** may be seated on the top surface of the ring part **151**.

The infuser **160** may be mounted in the water container **72** by holding the ring handle **153** of the infuser ring **150** while the infuser **160** is seated on the infuser ring **150** and then setting the lower side of the ring part **151** of the infuser ring **150** safely on the ring supporter **144** of the water container middle cover **142**. The infuser **160** may be easily separated from the water container **72** by holding the ring handle **153** of the infuser ring **150** to separate the infuser **160** from the water container **72**.

In the meantime, water supply into the water container **72** of the automatic water supplier **71** may be controlled depending on opening or closing the outer door **36**. Specifically, the automatic water supplier **71** may be controlled to perform water supply into the water container **72** when the outer door **36** is closed, and not to perform water supply into the water container **72** when the outer door **36** is opened.

When the outer door **36** is opened while the water is supplied, the water supply may be terminated. When the outer door **36** is closed again after the water supply is terminated, water supply may be continued until a certain amount of water is filled in the water container **72**.

After the certain amount of water is filled in the water container **72**, the automatic water supplier **71** may stop supplying water into the water container **72** before the water container **72** is separated from the water container installation space **73**. This is because the water in the water container **72** is less likely to shrink when the water container **72** remains being mounted in the water container installation space **73**.

Furthermore, the automatic water supplier **71** may be controlled through the control panel **25** to perform or not to perform an operation. Specifically, the control panel **25** may be equipped with an on button (not shown) to receive a user command to activate the automatic water supplier **71** and an off button (not shown) to receive a user command to deactivate the automatic water supplier **71**.

When the automatic water supplier **71** is activated by the user touching the on button, the aforementioned operation of the automatic water supplier **71** may be performed.

When the automatic water supplier **71** is deactivated by the user touching the off button, the automatic water supplier **71** may not supply water into the water container **72** even when the water container **72** is mounted in the automatic water supplier **71**.

Furthermore, the automatic water supplier **71** may be controlled to supply a certain amount of water into the water container **72** regardless of the water level of the water container **72** (required water supply) instead of being controlled to supply water into the water container **72** until a certain amount of water is filled in the water container **72** (auto-fill). In this case, the control panel **25** may be equipped with an extra button for required water supply (not shown) in addition to the on button and the off button.

When the required water supply function is activated by the user touching the button for required water supply, the automatic water supplier **71** may supply the certain amount of water into the water container **72** regardless of the water level in the water container **72**.

FIG. **15** is a perspective view of a rear side of an inner door of a refrigerator, according to an embodiment of the disclosure. FIG. **16** is a cross-sectional view of a water supply case illustrating flows of cold air of a refrigerator, according to an embodiment of the disclosure. FIG. **17** is a perspective front view of an inner door of a refrigerator, according to an embodiment of the disclosure.

Referring to FIGS. **15** to **17**, the water supply case **100** may include cold air holes formed to easily supply cold air of the storeroom **21** into the water-intake space **62** and the water container installation space **73** formed on the front of the water supply case **100**.

The cold air holes may include a first cold air hole **121** formed at the case cover **120** and a second cold air hole **112** formed at the main case **101**.

The cold air flowing into an inner space **122** between the case cover **120** and the main case **101** through the first cold air hole **121** may be guided to the water-intake space **62** and the water container installation space **73**.

The cold air holes may include a third cold air hole **117** formed between the case cover **120** and the rear case **115**. The cold air flowing into the inner space **122** between the case cover **120** and the main case **101** through the third cold air hole **117** may be guided to the water-intake space **62** and the water container installation space **73**.

As the cold air of the storeroom **21** is easily supplied to the water-intake space **62** and the water container installation space **73** through those cold air holes, the water container **72** mounted in the water container installation space **73** may be efficiently cooled.

Lamps **131** and **132** may be provided at the water supply case **100**. The first lamp **131** may be arranged in an upper portion of the water-intake space **62** to illuminate the opera-

tion lever **64**. The second lamp **132** may be arranged on a side of the water container installation space **73** to illuminate the water container **72**. The first and second lamps **131** and **132** may be arranged to be turned on or off in connection with opening or closing the outer door **36**.

FIG. **20** illustrates a refrigerator **200** with an outer door open, according to another embodiment of the disclosure. FIG. **21** illustrates a refrigerator **300** with an outer door open, according to another embodiment of the disclosure. FIG. **22** illustrates a refrigerator **400** with an outer door open, according to another embodiment of the disclosure. FIG. **23** illustrates a refrigerator **500** with an outer door open, according to another embodiment of the disclosure.

The same features as in the aforementioned embodiment are denoted by the same reference numerals, and the overlapping description will not be repeated.

As shown in FIG. **20**, it is also possible to omit the dispenser from the refrigerator as described above in the previous embodiment of the disclosure. In this case, the control valve may be a two-way valve instead of the three-way valve, and the flow path for guiding water from the water supply flow path to the dispenser may also be omitted.

As shown in FIG. **20**, positions of the dispenser and the automatic water supplier as described above in the previous embodiment of the disclosure may be reversed.

As shown in FIGS. **22** and **23**, the dispenser and the automatic water supplier as described above in the previous embodiment of the disclosure may be arranged not horizontally but vertically. The automatic water supplier may be arranged on the top of the dispenser or the dispenser may be arranged on the top of the automatic water supplier. In this case, the door guard arranged on the automatic water supplier and the dispenser, as described above in the previous embodiment of the disclosure, may be omitted.

In the embodiments of FIGS. **20** to **23**, internal parts of water supply cases **100***a*, **100***b*, **100***c* and **100***d* may be omitted or changed depending on whether the dispenser is omitted or positions of the dispenser and the automatic water supplier.

According to various embodiments of the disclosure, the energy loss of a refrigerator may be reduced by eliminating the need to open an inner door when the user accesses a dispenser or an automatic water supply.

According to various embodiments of the disclosure, the user may draw a water container forward from an inner door to take out the water container from an automatic water supplier, thereby improving usability of the refrigerator.

According to various embodiments of the disclosure, a dispenser and an automatic water supplier in a refrigerator may be formed in a single assembly, thereby improving assembling performance, durability, and the design.

According to the disclosure, a robot hand is able to open or close two links on one side and two links on the other side while synchronously operating a link connecting the two links on the one side and a link connecting the two links on the other side.

While the disclosure has been shown and described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the disclosure as defined by the appended claims and their equivalents.

What is claimed is:

1. A refrigerator comprising:

a main body including a storeroom;

an inner door rotatably couplable to the main body;

an outer door rotatably arranged in front of the inner door;

a dispenser including a dispenser nozzle and an operation lever, the dispenser being arranged at the inner door and accessible while the outer door is opened and the inner door is closed, the dispenser configured to supply water through the dispenser nozzle by manipulation of the operation lever;

an automatic water supplier including an outlet spaced apart from the dispenser nozzle and a water level sensor, the automatic water supplier being arranged at the inner door and accessible while the outer door is opened and the inner door is closed, the automatic water supplier configured to supply water through the outlet until a predetermined water level is detected in a water container by the water level sensor;

a first flow path configured to allow water to flow to the dispenser nozzle;

a second flow path configured to allow water to flow to the outlet; and

a control valve configured to open or close the first flow path to supply water to the dispenser and to open or close the second flow path to supply water to the automatic water supplier,

wherein the control valve is configured to open the first flow path by manipulation of the operation lever while the outer door is opened and configured to close the second flow path while the outer door is opened.

2. The refrigerator of claim **1**, further comprising: a water supply case arranged at the inner door and forming a water container installation space for the water container to be mounted in the water container installation space and be removed from the water container installation space.

3. The refrigerator of claim **2**, wherein the automatic water supplier further comprises a water container sensor configured to detect whether the water container is mounted in or dismounted from the water container installation space, and

the control valve is configured to close the second flow path in response to the water container being dismounted from the water container installation space.

4. The refrigerator of claim **1**, wherein the automatic water supplier comprises a tray arranged to receive water overflowing from the water container; and

an overflow sensor configured to detect a water level in the tray,

wherein the control valve is configured to close the second flow path in response to a detected water level in the tray, detected by the overflow sensor being equal to or greater than a predetermined water level.

5. The refrigerator of claim **1**, further comprising:

a control panel including a button for selecting a turning on function of the automatic water supplier or a turning off function of the automatic water supplier,

wherein the control valve is configured to close the second flow path in response to a selection of the turning off function of the automatic water supplier through the control panel.

6. The refrigerator of claim **1**, wherein the control valve is a two-way valve comprising an inflow port connectable to a water source to receive water, and an outflow port supplying the water to the automatic water supplier.

7. The refrigerator of claim **6**, wherein the outlet and the outflow port are integrally formed.

8. The refrigerator of claim 2, wherein the control valve is mountable in an upper portion of the water supply case so that the control valve is located above the water container installation space.

9. The refrigerator of claim 2, wherein the water level sensor is installable on a surface of the water supply case to come into contact with the water container while the water container is mounted in the water container installation space.

10. The refrigerator of claim 3, wherein the water container sensor is installable in an upper portion of the water supply case to be located in an upper portion of the water container while the water container is mounted in the water container installation space.

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